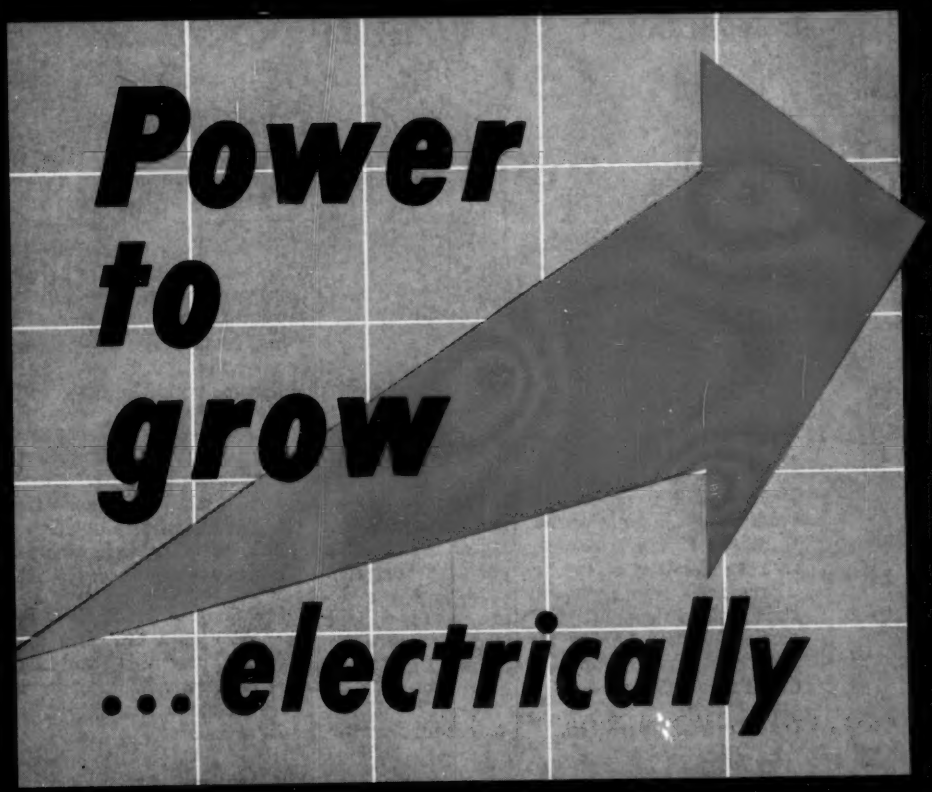
GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES • A McGRAW-HILL PUBLICATION

Power

SEPTEMBER
1956 • 50¢



A program of major industrial significance ▲ 75

The A-S-H Hydro-Ejector for conveying solids...

Cut-away view illustrates operation and typical arrangement of Hydro-Ejector application.

Where jet apparatus is indicated, we suggest our improved A-S-H Hydro-Ejector—most efficient of all jet pumps.

Simplicity of Design. Dependable operation is insured by the simple and compact design of the unit. The Hydro-Ejector corresponds closely in size and shape to the transporting pipeline. There is a minimum of joints or other restrictions to flow. All joints are machined and gasketed. The jet nozzle tip is located out of the path of the materials being handled and thus doesn't interfere with the free flow of solids.

Trouble-free Operation. High pressure water admitted through the jet nozzle transports solid materials at high velocity through a diverging throat into the transport piping. Iron pyrites can be transported in the same system with bottom ash or furnace slag. This combined operation saves time and water, and uses the greater specific gravity of a water-and-ash mixture to convey the heavy pyrites more efficiently. The Hydro-Ejector cannot become air-bound. All units are shop tested under service conditions before shipment.

Low Maintenance. Long service life is assured by (a) use of wear resistant materials (b) use of few connecting joints within the unit and (c) locating the jet nozzle tip out of the path of material in transport. Special gaskets are available to withstand effects of acids, alkalis and high temperatures.

Simplicity of Installation. Installing the Hydro-Ejector as a unit is a simple operation. It is factory assembled and has only three points of attachment. Maintenance problems are minimized since the unit is easily assembled and disassembled.

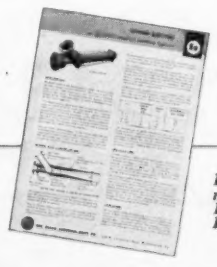
The **Allen-Sherman-Hoff** Company

259 E. Lancaster Ave., Wynnewood, Pa.

Offices and Representatives in Principal Cities

MATERIALS HANDLING SYSTEMS

hydrojet *hydraulic* / **hydrovac** *pneumatic*

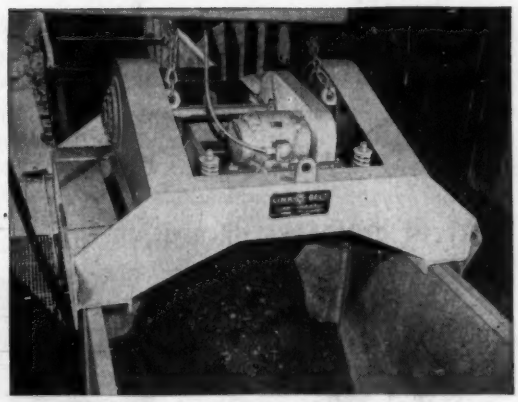


For complete information on Hydro-Ejectors send for Data Sheet Ea.

OVER AND OUT

ROTARY DUMPERS, for large plants, will unload 160 or more cars in one eight-hour day and take all open type cars of any length, width or height. Operation is simple, automatic, foolproof.

LINK-BELT Rotary Dumpers empty gondola cars in one minute or less



CAR SHAKERS cut unloading time, free manpower. One man with a Link-Belt Car Shaker can empty a car "broom-clean" in minutes.

MEET all unloading needs, from the largest to the smallest, with push-button emptying of gondola cars by a Link-Belt Rotary Dumper or Car Shaker. Both are precision-engineered to do a specific job faster . . . easier . . . at lower cost. Rotary dumpers are designed to unload 15 or more cars per hour and, for smaller operations, car shakers will unload 15 or more cars per day. To improve your car unloading operations, whatever the size of your plant, contact your nearest Link-Belt representative.

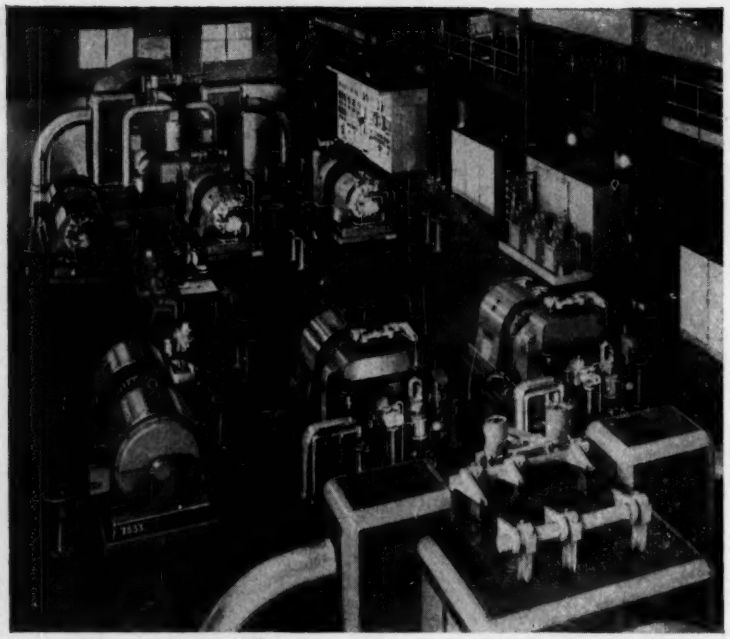
LINK-BELT

14.085

ROTARY DUMPERS and CAR SHAKERS

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

What makes a barrel-type boiler feed pump *stay in service?*



Here are some of the design features that assure dependability

Today's modern multi-stage centrifugal pumps for boiler feed service are the result of years of research and design. To provide efficient service *plus* dependability, De Laval has incorporated these important features in its barrel-type pump.

Double Volute Diaphragms

Double volute diaphragms provide for radial hydraulic balance and assure a continuous rising head characteristic from the design point to shut-off. *RESULT—Higher efficiencies are maintained over a wider range of operation than are generally obtained with other forms of velocity pressure conversion.*

Individual Diaphragm Bolting

Elimination of rabbet fits and gaskets permits straight metal-to-metal contact of adjacent lapped faces of the diaphragms which are individually bolted together to maintain tight joints and ease of assembly. *RESULT—Positive assurance against inner case leakage, complete elimination of misalignment causes and a minimum of distortion from sudden temperature changes.*

Positive Sealing Between Suction and Discharge Chamber

Inner assembly is held at the inner high pressure joint at the suction end of the barrel, against a flexitallic gasket, with through bolts. The joint between the suction and discharge chambers is made tight during assembly—remains tight whether pump is operating or idle. *RESULT—No possibility of leakage or gasket loosening due to changes of force on the inner joint.*

Bare Shaft

Bare shaft construction with split ring-shrink fit method of impeller mounting permits a scalloped shaft design and eliminates the need for spacer sleeves between impellers. *RESULT—Better hydraulic conditions at the eye of the impeller and elimination of spacer sleeves—the greatest cause of shaft warpage.*

Wearing Rings

Diaphragms and impellers have renewable wearing rings. Impeller rings are threaded on the impeller hubs against rotation, and diaphragm rings are held by a breech lock fit in the diaphragms. *RESULT—Construction permits renewal of original clearances without major part renewal or modification. Labyrinth type diaphragm ring results in minimum leakage over a longer period of time than with close clearance flat rings.*

IMO Oil Pump

A De Laval IMO pump designed for high speed operation is direct-connected to the outboard end of the barrel pump shaft, and is sized to lubricate both pump and driver bearings. *RESULT—Quiet, pulsation-free, positive displacement IMO pumps, assures positive lubrication and eliminates the need of extra shaft length and mechanical complications required by gear drive lube oil pumps.*

BULLETIN CONTAINS HELPFUL DATA

This De Laval bulletin on the barrel-type boiler feed pump covers all major design points . . . has cross-section cut-away illustration for easy reference. Write on your business letterhead for your copy of Bulletin 1506 to De Laval Steam Turbine Company, 815 Nottingham Way, Trenton 2, New Jersey.

Power

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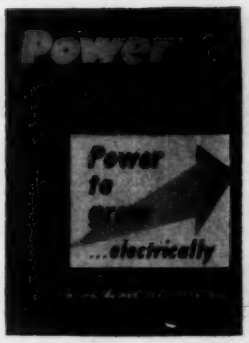

PTG . . . electrically, POWER's new editorial program, will show the need for planning ahead in the industrial electrical distribution area. After more than a year of cogitating all angles, visiting plants, talking with the country's top electrical engineers and manufacturers, POWER editors launch the series on p 75.

Designing a symbol to identify the program and serve as a PTG index took a bit of head scratching. Aim was to depict growth—both graphically and artistically. Result is shown on this month's cover.

Next month . . .

Report from Moscow takes priority in the October issue. Shelton Fisher, POWER's publisher, is probing into the power status of the U.S.S.R., promises to return with a full report on how Russian practice compares with ours.

A recent cablegram indicates his meeting with Georgi Malenkov, Minister of Power Stations, was most productive. Don't miss this article.

Water treatment program at Dominion Foundries' Hamilton, Ont. plant converts 15 million gallons per day of turbid bay water into industrially-clean odor-free process water. Upcoming 3-pager gives the highlights.

Unconventional approach to providing 4000 tons of air conditioning for the Socony Mobil building in New York City resulted in a practical low-cost installation. Watch for the full story.

. . . *and future months*

Corrosion, the $6 billion yearly headache of American industry, is theme of 32-p report slated for December.

September 1956 POWER Vol. 100—No. 9

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POWER articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own annual index.

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THIS WESTERN power plant (name on request) has a total capacity of 214,000 kw. All turbines are lubricated exclusively with *Texaco Regal Oil R&O.*

THE SPECIAL rust and oxidation inhibitors (R&O) in *Texaco Regal Oil R&O* assure your turbines a wide additional margin of safety—protection against any unforeseen increase in severity of operating conditions. And this added protection lasts throughout the long service life of the oil.

Even under severest conditions, rate of neutralization number rise is much slower for *Texaco Regal Oil R&O* than for ordinary turbine oils. And *Texaco Regal Oil R&O* has proved, in turbines of every type and size, its ability to keep systems clean, to prevent rust, sludge and foam, to assure normal bearing temperatures and instantaneous governor response.

There is a complete line of *Texaco Regal Oils R&O* to meet the exacting requirements of all leading turbine builders. A Texaco Lubrication Engineer will gladly help you select the proper one.

JUST CALL the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

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The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Regal Oils R&O

FOR ALL TURBINES

speaking of **Power**

Publisher Shelton Fisher and Editor Lou Rowley pack data . . .

for Fisher's tour of U.S.S.R. power plants

How does U.S.S.R. power stack up? Fisher flies to find out

In Moscow, as this is written, Shelton Fisher, POWER's publisher, seeks first-hand answers to a question looming large in many a reader's mind: How does Russian practice compare with ours? As the first member of the U.S. industrial press to be given an opportunity to tour U.S.S.R. power facilities since the cold war "thawed," he hopes to bring back the kind of eyewitness report that has long been lacking on this important technical area.

It all started this spring, with a letter to His Excellency Georgi M Malenkov, once Premier of the U.S.S.R. and now Minister of Power Stations. In the letter, forwarded through the U.S.S.R. embassy in Washington, Fisher said, in part:

"Last summer, as you know, our countries exchanged agricultural delegations. The point of their inquiry, and the objective of all people in agriculture, is to enable the soil to produce more.

"The work of your Ministry, and indeed of the magazine and industry I represent, is to enable the *people* to produce more.

"POWER magazine would like to know what your ambitions are, what success you have had, what particular technical progress has been achieved in recent years.

"I offer, if necessary, to limit my interview to a series of questions . . . prepared and submitted in advance. . . . I would be prepared, of course, to answer your similar questions . . . . And I earnestly believe such an interchange would be interesting and helpful to each of us."

Visa authorization came through in unusually short time, followed by a letter from the Ministry of Power Stations confirming arrangements for plant visits. From these visits and from conversations with U.S.S.R. power authorities should come a story of real interest and importance to all POWER readers. Watch for it in the October issue.

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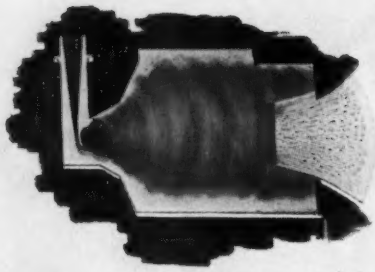
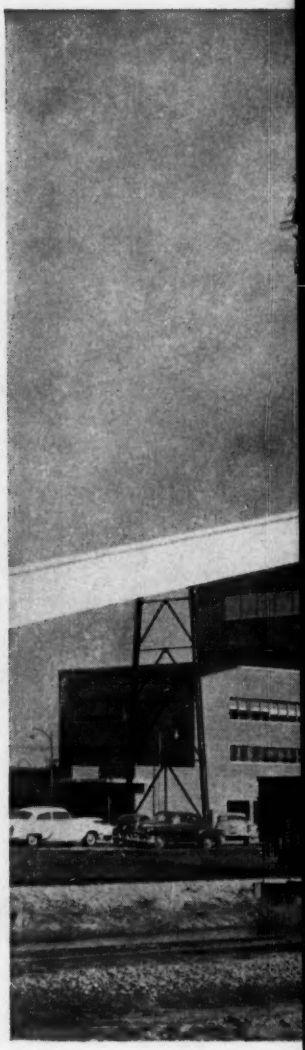
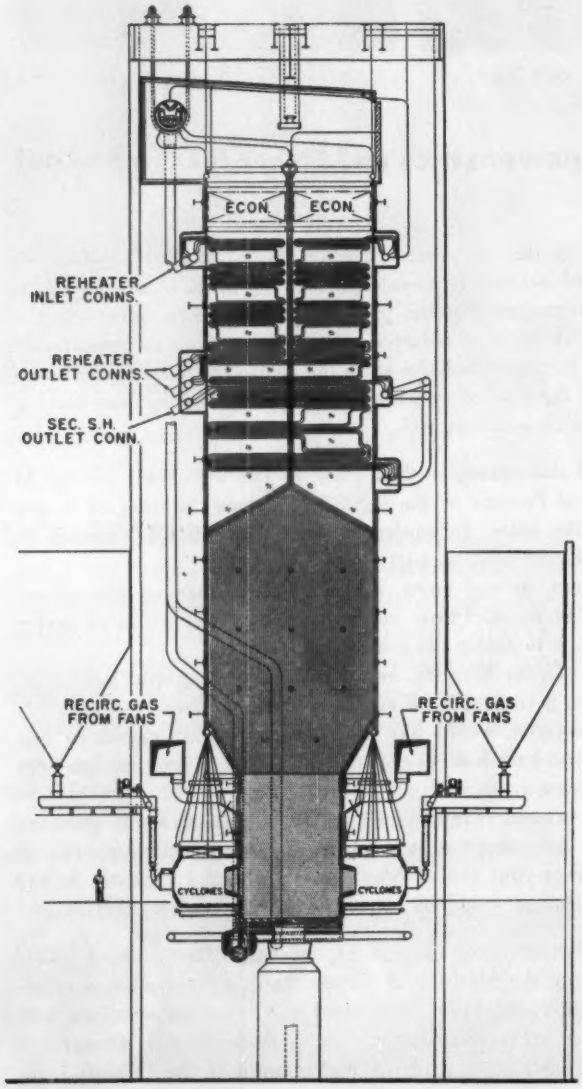


CYCLONE FURNACE FOR ST. CLAIR



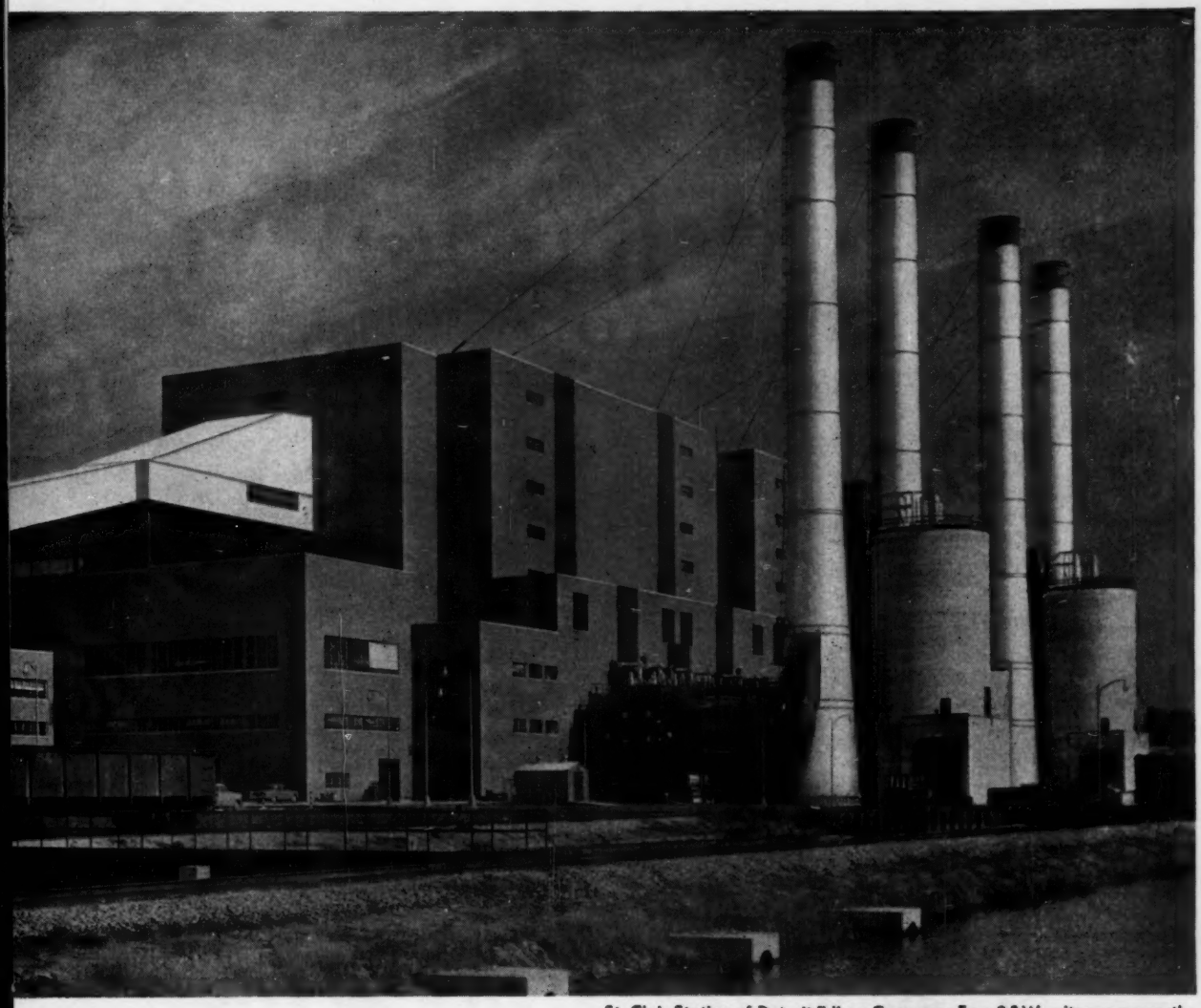


Detroit Edison Company's pioneering of more efficient power generation with better boilers, larger turbines and technical improvements of many kinds takes another step forward with the selection of a Cyclone Furnace-fired B&W Radiant Reheat Boiler for St. Clair Station.

The new generating unit will provide guaranteed capability of 325,000 kw, and the boiler will deliver 2,100,000 lb of steam per hr at 2450 psi and 1050 F at the superheater outlet. Reheat temperature is 1000 F.

ELIMINATION OF HEAVY FLY-ASH DISCHARGE WITH CYCLONE FURNACES

Cyclone Furnace Boilers offer many advantages. One important feature is the elimination of heavy fly-ash discharge from the stack. Most of the ash from the burning coal is melted into easy-to-handle slag right in the Cyclone Furnace. This ash never gets into the gas stream, with the result that dust loading is reduced to very small amounts.



St. Clair Station of Detroit Edison Company. Four B&W units are presently in operation, and a fifth unit—Cyclone Furnace-fired—is now on order.

The Cyclone Furnace offers many other benefits. Through simplification of the entire process of coal preparation, combustion, ash segregation, and ash handling, it makes possible economies in inital cost, operating labor and fuel consumption. Maintenance costs are cut because so much maintenance-causing machinery is eliminated. These are some of the reasons why fifty-six boilers of all sizes are now in operation or on order with a total of over 130 Cyclone Furnaces.

CLEAN STEAM WITH CYCLONE SEPARATORS

Adequate circulation of water throughout the boiler —even at the high design pressure of 2700 psi for the St. Clair unit—is assured with safety by B&W's efficient Cyclone Steam Separators. Located inside the drum, these simple, stationary devices require no power, need no maintenance, do not take up building room. In conjunction with Steam Scrubbers, the Cyclone Separators make it possible to send steam of highest purity to the turbine, contributing to greater turbine efficiency and decreasing the amount of turbine cleaning required.

* * *

These and many other modern advances in combustion and high-pressure, high-temperature steam generation are available to you. We will be glad to discuss them with you in connection with your future plans. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

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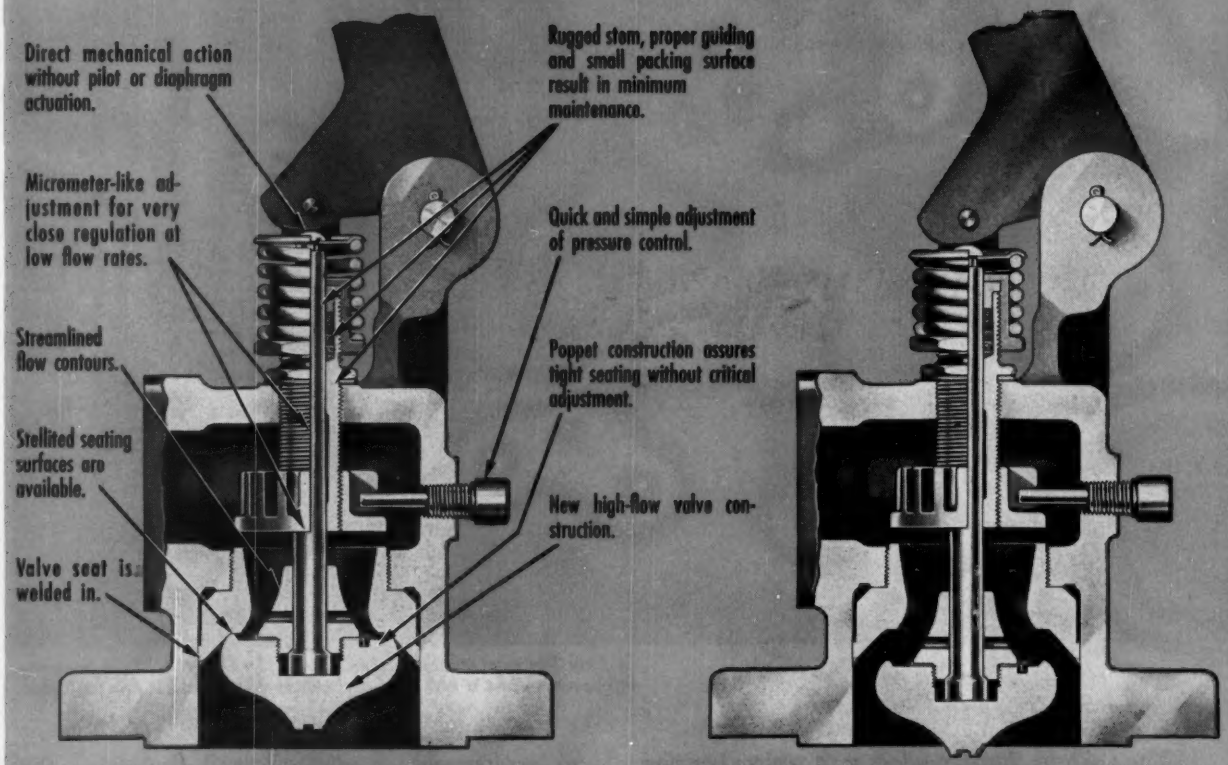
BABCOCK & WILCOX

BOILER DIVISION

POPPET TYPE VALVES


Direct mechanical action without pilot or diaphragm actuation.
Micrometer-like adjustment for very close regulation at low flow rates.
Streamlined flow contours.
Stellited seating surfaces are available.
Valve seat is welded in.
Rugged stem, proper guiding and small packing surface result in minimum maintenance.
Quick and simple adjustment of pressure control.
Poppet construction assures tight seating without critical adjustment.
New high-flow valve construction.

CLOSED **OPEN**

Demands on a soot blower valve are extremely severe . . . performance requirements very high. Long experience has shown that the poppet type valve is the most satisfactory unlubricated valve for such rugged work. (It is also used in automobile engines.) The Diamond Poppet Type has proved its superiority by many years of successful operation on the most difficult jobs . . . it is an important factor in the outstanding performance of the blowers shown on the opposite page.

NEW streamlined flow contours substantially reduce pressure drop. Valve design assures tight seating without close adjustments. Valve seat is welded in on all steel valves; Stellited seating surfaces are available. The valve readily lends itself to examination and repair. Disc and seat are quickly accessible, and regrinding can be done quickly without dismounting the head. Seat, disc and stem are corrosion resistant stainless steel.

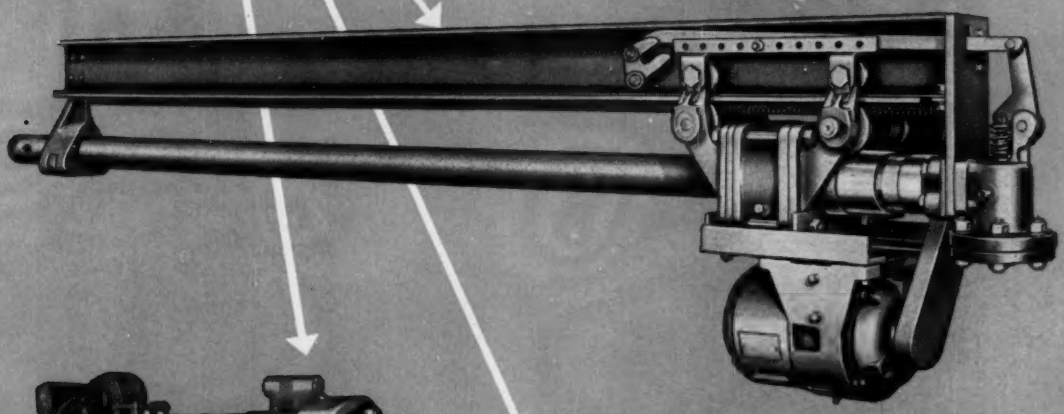
The integral adjustable pressure control device is used when boiler pressure is higher than desirable for blowing . . . but not so extreme as to require a separate pressure reducing valve. It permits accurate setting of the blowing pressure for each blower individually . . . entirely independent of every other blower. It is easily and quickly adjusted . . . consists of a ribbed disc carried on the threaded valve stem guide. Its location outside the path of valve travel permits full and immediate opening of the poppet valve, thus avoiding wire drawing. Throttling is at the back seat so that the main seat is spared the damaging action of this duty. No orifice in line is necessary.

The poppet valve is one of the many reasons why Diamond Blowers give *better boiler cleaning at lower cost.*

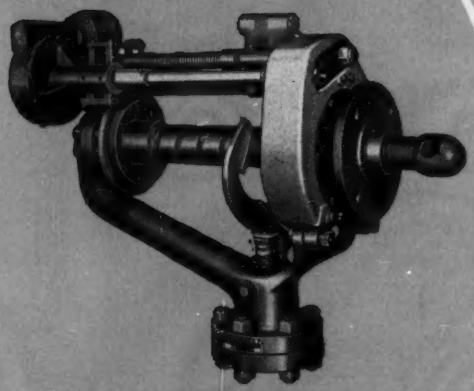
Model IK valve shown above; Models IR and G98 valves have same advantages.

7549

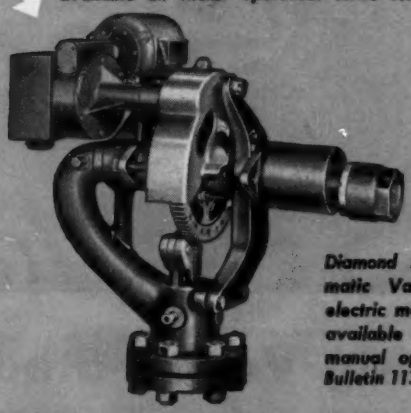
An IMPORTANT REASON for the better performance of these Diamond Blowers



Diamond Model IK Long Retracting Blower with mechanically operated valve. Electric motor operated unit shown; also available air motor operated. Write for Bulletin 1080A.

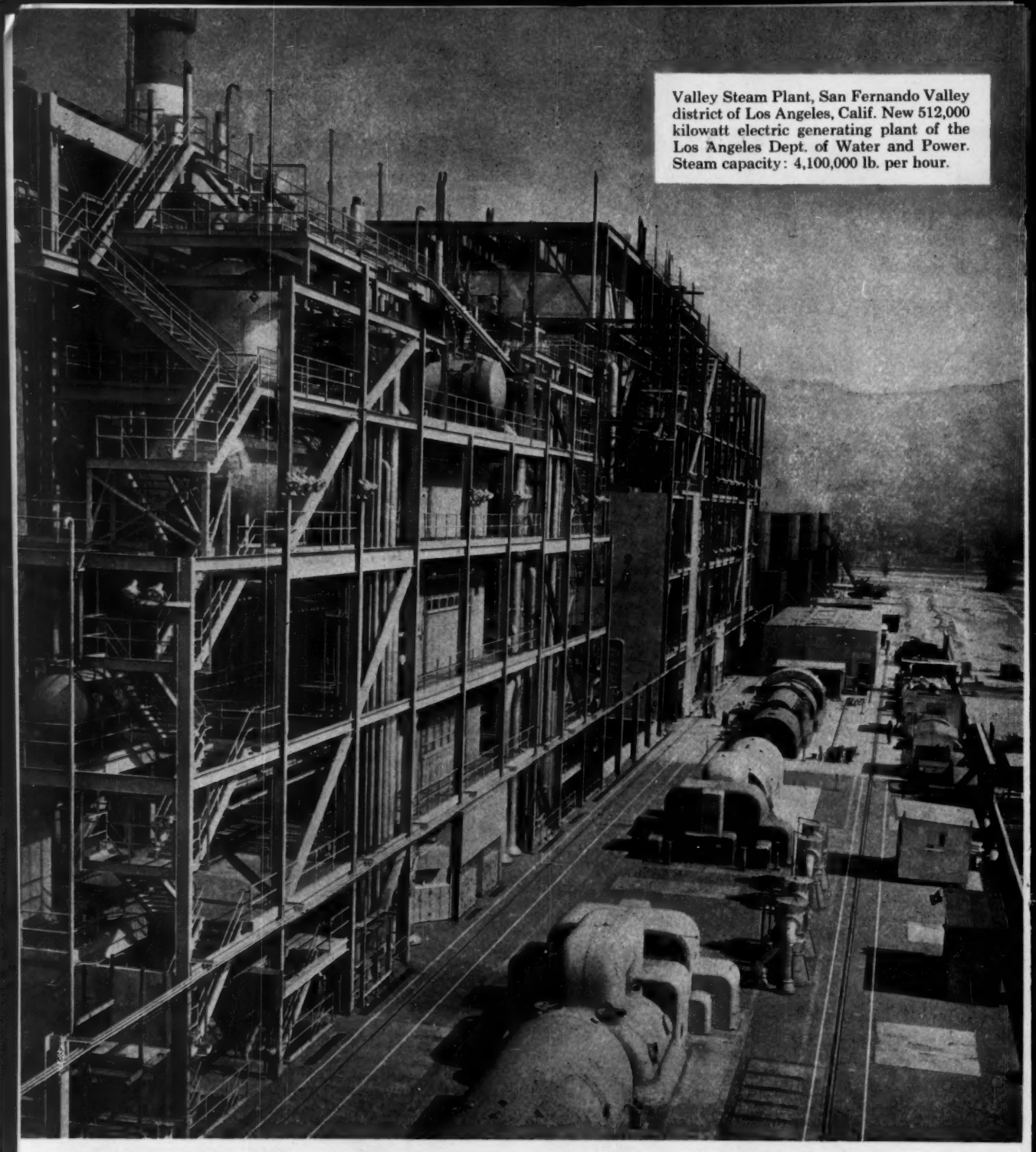


Diamond Model IR Short Retracting Blower with air motor operation; electric or manual operation also available. Write for Bulletin 1079.



Diamond Model G9B Automatic Valved Blower with electric motor operation; also available with air motor or manual operation. Write for Bulletin 1137U.

DIAMOND POWER SPECIALTY CORPORATION
LANCASTER, OHIO
Diamond Specialty Limited • Windsor, Ontario



Valley Steam Plant, San Fernando Valley district of Los Angeles, Calif. New 512,000 kilowatt electric generating plant of the Los Angeles Dept. of Water and Power. Steam capacity: 4,100,000 lb. per hour.

How big Valley Steam Plant demineralizes

• Valley Steam's feedwater requirements are typical for today's modern, high-capacity stations. Its raw water supply, delivered from the Los Angeles Owens River Aqueduct, contains 132 ppm total solids but is high in dissolved silica (18 ppm). The 1500 psig and 1850 psig boilers require a large amount of high quality feedwater.

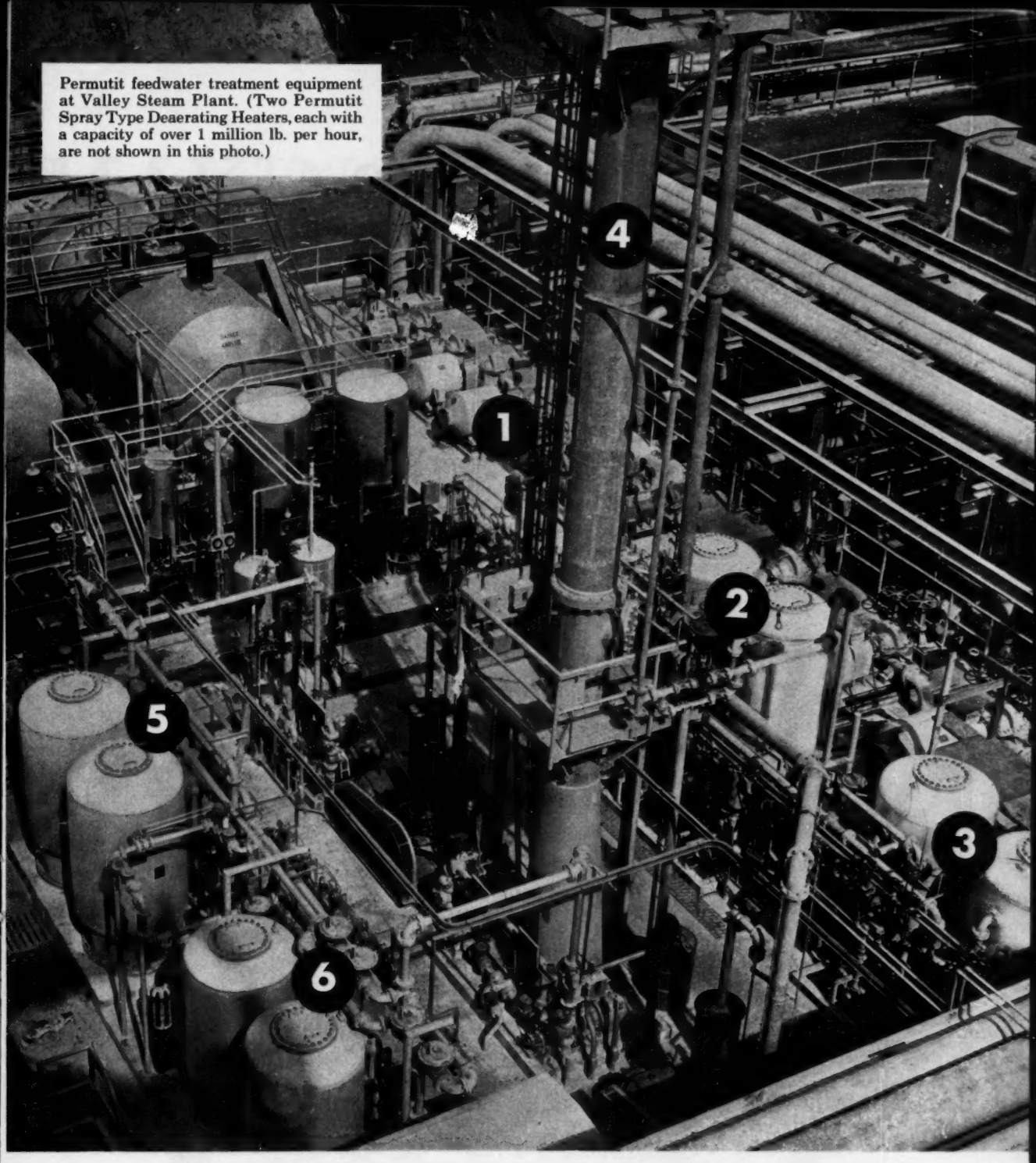
The 4-step PERMUTIT Demineralizer was custom-designed for this problem . . . not only in size, arrangement and number of ion exchange units, but also in the selection of the ion exchange resins.

That's why Permutit's broad experience with many different demineralizing systems and its manufacture of ion exchange resins as well as equipment are of particular value in solving large-plant water problems.

The Permutit Company, Dept. P-9, 330 West 42nd Street, New York 36, N. Y. Permutit Company of Canada, Ltd., 207 Queens Quay, Toronto 1, Ontario.

PERMUTIT EQUIPMENT FOR POWER PLANTS:

Demineralizers • Zeolite and Hot-Process Softeners • Dealkalizers • Deaerating Heaters • Pressure and Gravity Filters • Chemical Feeders • Aerators • Blowoff equipment • CO_2 Indicating Recorders • Zeolites and Resins • Instrument Panels • Control Cubicles



Permutit feedwater treatment equipment at Valley Steam Plant. (Two Permutit Spray Type Deaerating Heaters, each with a capacity of over 1 million lb. per hour, are not shown in this photo.)

its feedwater with **PERMUTIT**® equipment

1 Diatomite filters (behind column) remove dirt and other suspended matter . . . keep ion-exchanger beds clean for top efficiency.

2 Primary hydrogen cation units contain Permutit Zeo-Karb® . . . remove metallic cations such as calcium, magnesium, sodium.

3 Weakly basic anion units contain Permutit A exchange resin . . . remove chlorides, sulfates, nitrates.

4 Vacuum deaerator removes CO_2 at low cost. Reduces the load on the second stage anion exchangers.

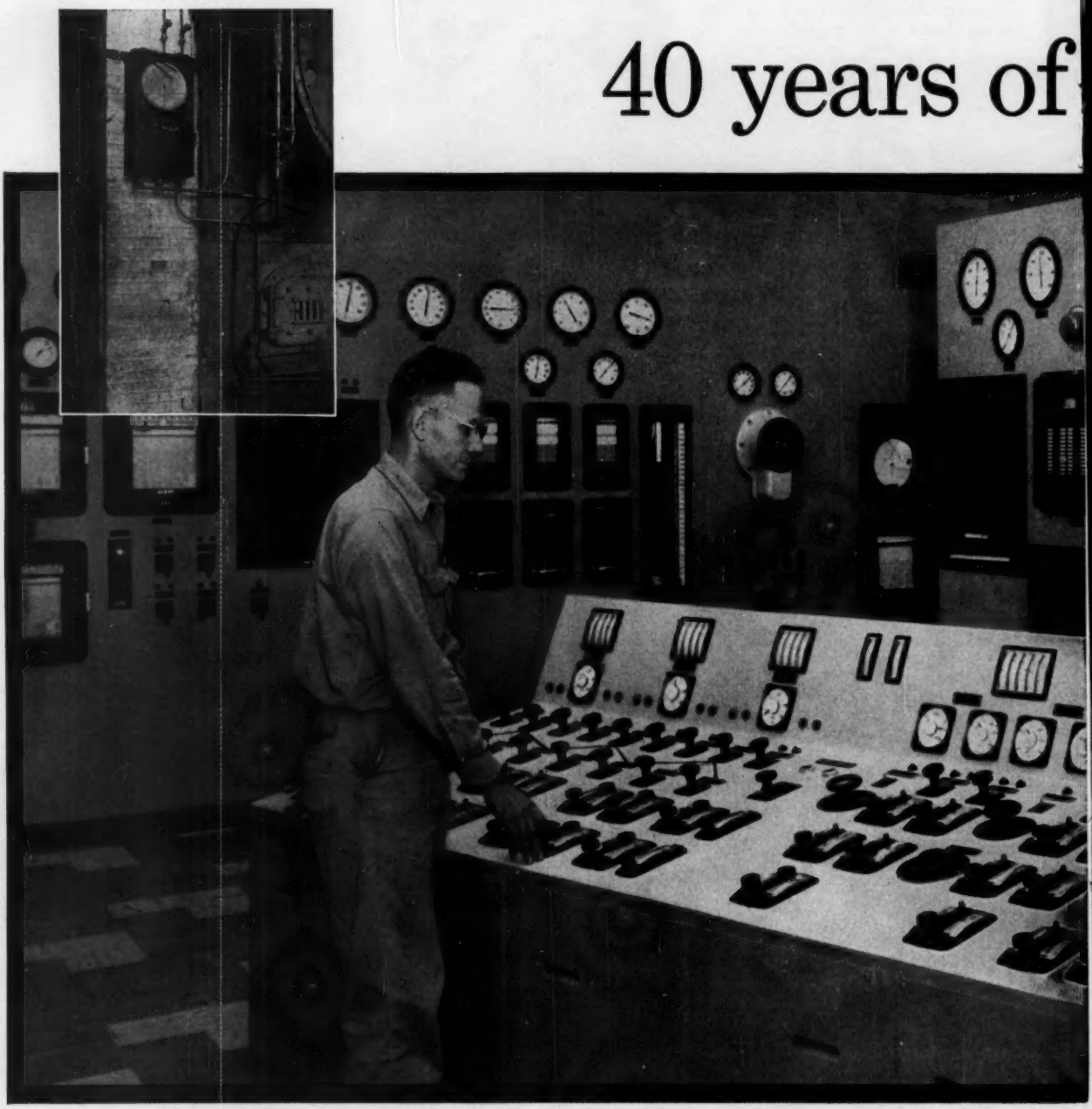
5 Secondary hydrogen cation units (Zeo-Karb) "polish" water by removing "slippage" from first cation units.

6 Strongly basic anion units contain Permutit S-2 resin . . . remove dissolved silica . . . also catch "slippage" from first anion units.

Quality of effluent: Zero free CO_2, under 1 ppm total solids, under 0.2 ppm silica.

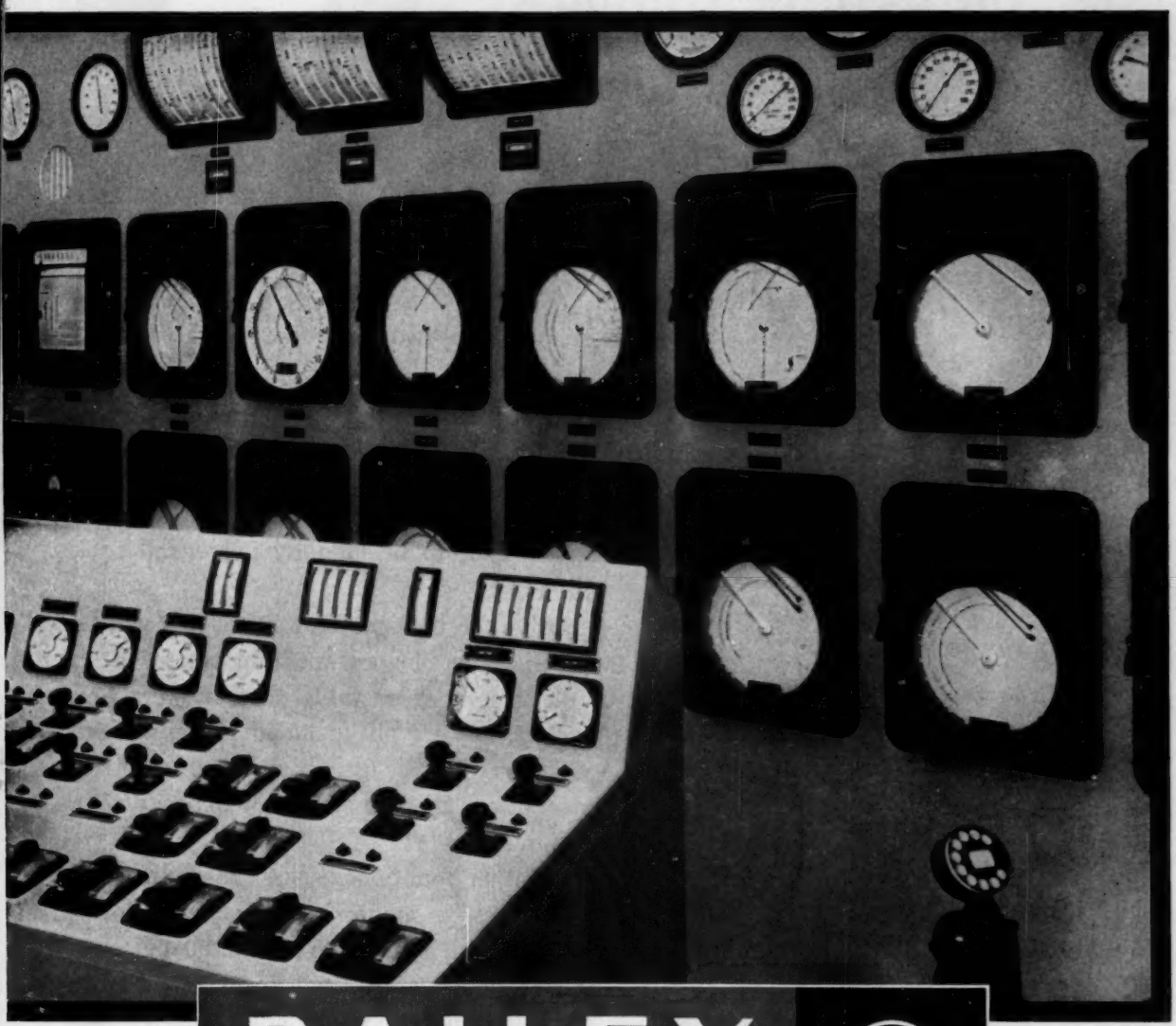
For highest efficiency and lowest operating cost, the regeneration of the demineralizing equipment is completely automatic and operated by Permutit instrument panels and control cubicles.

40 years of



As ASME celebrates its 75th, Bailey Meter Co. completes its 40th year . . . The contrast between the Bailey installation of 1916 and the control room of today shows 40 years' progress in boiler control. In this progress, the completeness of the Bailey line has played its part, as has the breadth of Bailey Engineering Service . . . but most important has been a steadfast service policy of *making it work. That policy is expressed today in the most widespread network of Sales-Service Engineers provided by any manufacturer of boiler control systems,* sustaining the reputation of *the company built on service.*

"MAKING IT WORK"...

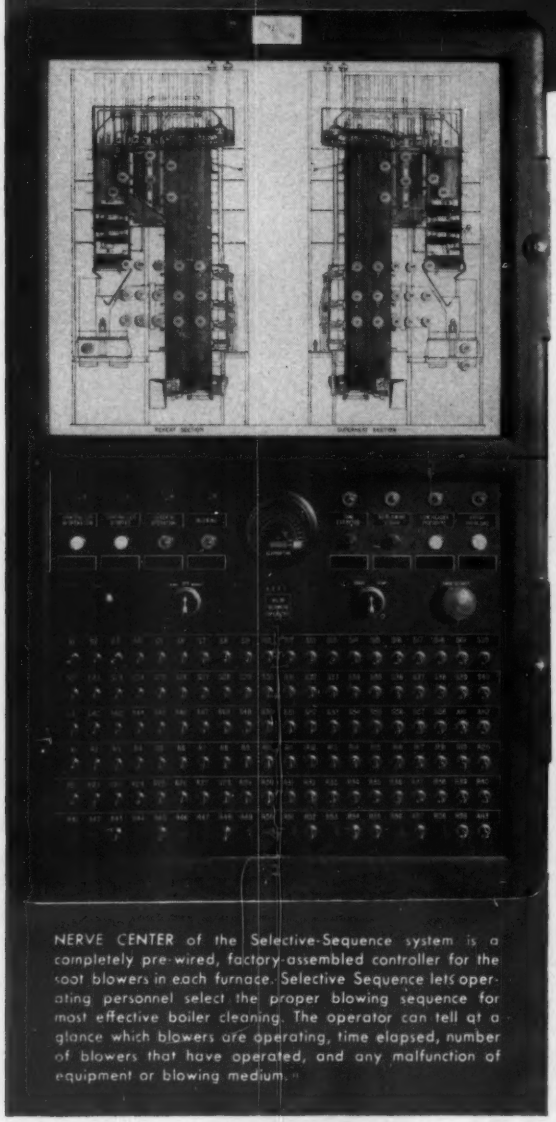


BAILEY
METER COMPANY
1036 IVANHOE ROAD
CLEVELAND 10, OHIO
Complete Controls for Steam Plants

BAILEY METERS
Controls for
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS

A127-2

It's Vulcan Selective Sequence for Astoria Station's 2,400,000 lb./hr. Boiler!



NERVE CENTER of the Selective-Sequence system is a completely pre-wired, factory-assembled controller for the soot blowers in each furnace. Selective Sequence lets operating personnel select the proper blowing sequence for most effective boiler cleaning. The operator can tell at a glance which blowers are operating, time elapsed, number of blowers that have operated, and any malfunction of equipment or blowing medium.

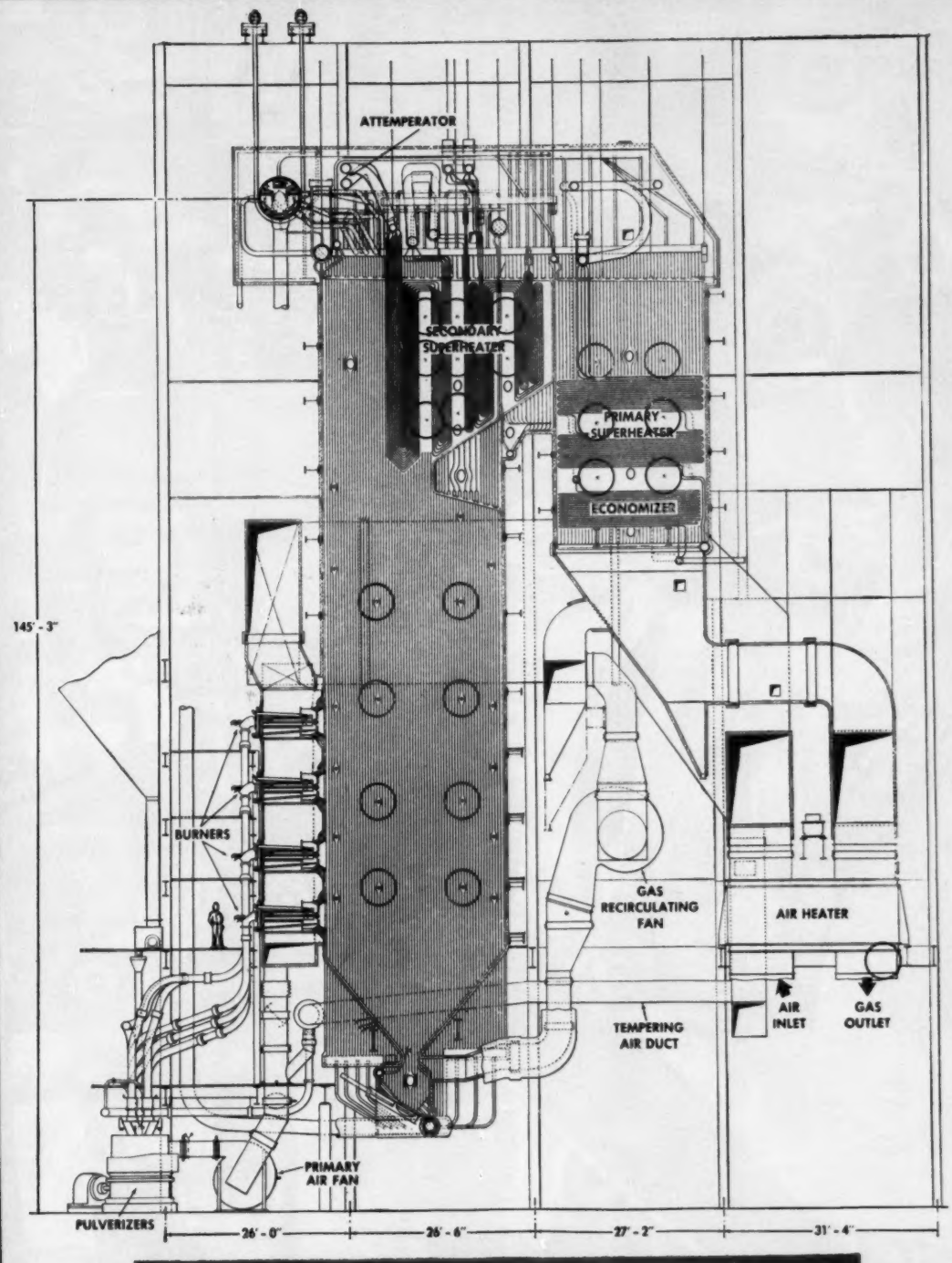
Each of the two forty-foot furnaces firing Consolidated Edison's Boiler 30 at Astoria Generating Station will be equipped with a custom-designed Vulcan Selective-Sequence Soot Blowing System. The boiler now being built by Babcock & Wilcox is a radiant-reheat type to be fired by pulverized coal, oil or gas.

Drive for the soot blower systems will be electric; the blowing medium steam. Both Vulcan long retractable soot blowers and wall deslaggers are included in the system. Vulcan wall deslaggers maintain high striking power, keep thickness of deposits to a minimum.

Whether your boiler is large or small, power or process—a modern Vulcan Soot Blower System with automatic-sequential or selective-sequence control will keep it operating at peak efficiency. Your Copes-Vulcan representative has the ideas, information and experience to help you choose the system best suited to your needs.

COPES-VULCAN DIVISION
BLAW-KNOX COMPANY
ERIE 4, PENNSYLVANIA

50th Anniversary
BLAW-KNOX
1906-1956

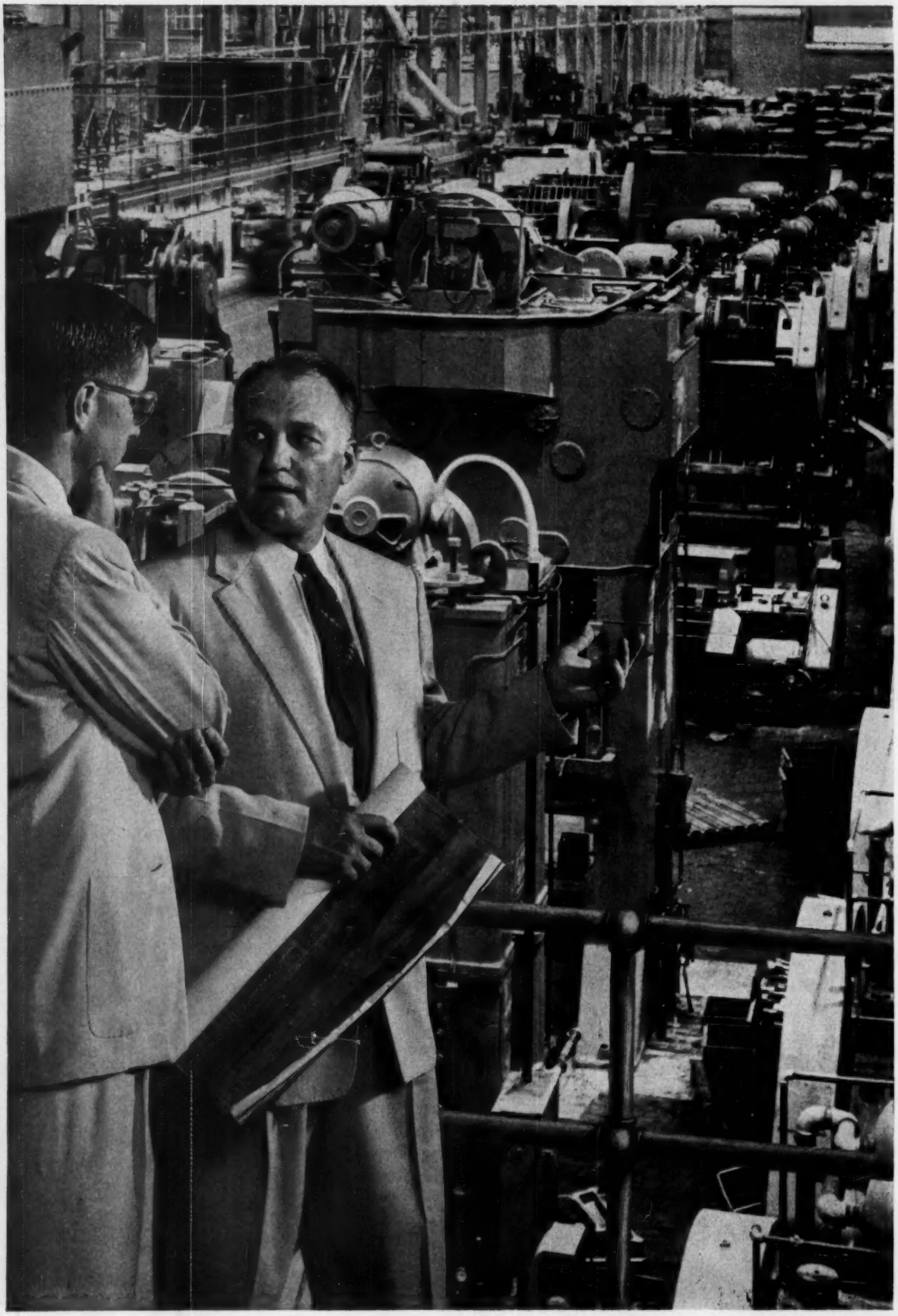


CONSOLIDATED EDISON COMPANY

ASTORIA GENERATING STATION, NEW YORK, NEW YORK

BABCOCK & WILCOX TWIN-FURNACE BOILER
2—40'-0" FURNACES

Capacity, Lb. Steam per Hour...2,400,000 Superheater Outlet Pressure, PSI.....2,150
Design Pressure, PSI.....2,500 High Pressure Steam Temperature, F..1,050
Reheat Steam Temperature, F.....1,000



"What would you say if your boss asked . . .

'Are we ready for automation?'"

"Two years ago I didn't know the answer when the boss asked me, 'Are we ready for automation . . . electrically?'

"As plant electrical services engineer I had to come up with the answer . . . and it was a real surprise. Much of our electric equipment was antiquated and took up a lot of valuable production space. The power supply wasn't as safe, dependable or flexible as we wanted it . . . maintenance costs were soaring.

"We had spent so much time improving manufacturing processes and methods that we had neglected electrical needs. Result . . . we weren't even up to date, let alone prepared for automation.

"Steps were taken immediately to make sure our plant was adequate electrically. Today it has more automatic equipment and work-handling devices, and is equipped for more advanced types of automation. Electrical adequacy is being designed into our new branch plant, too.

"There's no reason why you can't do the same to make your plant more efficient."

J-96100-1

Industry has electrical adequacy problems . . .

Surveys show that many of the nation's plants are inadequate electrically. A recent study of 42 plants in a given area revealed 88% had electrical problems that interfered with production.

These Problems Can't Wait

	Percent of Plants Inadequate — Electrically*
Inadequate transformer capacity and flexibility	42%
Questionable breaker interrupting capacity	63%
Lack of power centers	62%
Poor power factor	25%
No motor control centers	42%
No plug-in bus duct	32%
Low primary distribution voltage (below 4160 volts)	49%
Low secondary voltage (below 480 volts)	25%
Lack of network distribution systems	90%
Lack of automatic switching to maintain continuity	69%
Absence of 277-volt lighting	94%

*Based on report of survey in 156 top U.S. plants conducted by *Factory* magazine.

WATCH WESTINGHOUSE!

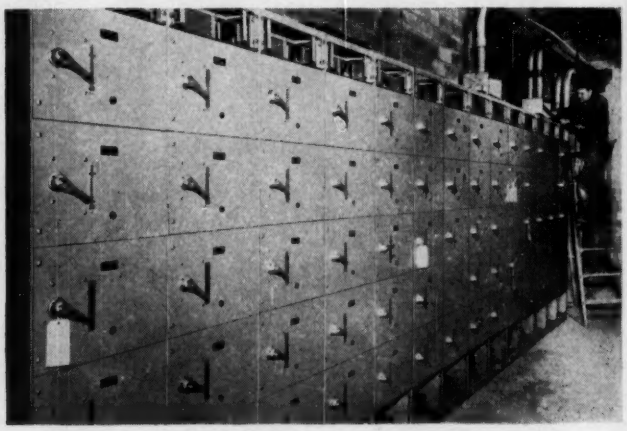
COVER THE PRESIDENTIAL CAMPAIGN ON CBS TV AND RADIO!

"I called in Westinghouse...

We got dependable, flexible power supply for greater productivity"

Westinghouse switchgear is available in 10 basic units with a selection of standard instrument panels . . . future additions or replacements can be made easily and quickly any time.

Westinghouse dry-type transformers save space, mount conveniently in out-of-the-way places. Well suited for wet, dirty or hot locations. Placement close to work load saves long, costly secondary runs.



Expansion with Westinghouse control centers frequently saves as much as 40% on installation costs over decentralized methods of mounting motor control. Inspection and service are simplified.

"When I found what some of our troubles were, I called in some expert help from Westinghouse. Working with our staff and our consulting engineers, Westinghouse further studied the condition of our plant power distribution system . . . its construction, age and state of repair.

Switchgear improved safety, operating continuity

"We installed Westinghouse low-voltage, metal-enclosed switchgear which had high interrupting capacity for safety and operating continuity. This reduced our maintenance, brought economic advantages and freedom to expand our facilities.

"Unitized switchgear reduced special design and engineering expense for our new installation, and also provided custom-built preciseness in meeting our application requirements.

Capacitors paid for themselves in 18 months

"Capacitors were carefully applied with Westinghouse help at the substation bus, on secondary bus duct, and right at the motor loads. In the first year, savings on our power bill amounted to 75% of capacitor installed cost. Capacitors paid for themselves in 18 months, and savings are still being realized.

"The capacitors reduced the burden on our feeders and released electrical capacity for other needs. We got better voltage regulation at our motor and lighting loads.

Transformers gave us power . . . where we wanted it

"Placing Westinghouse transformers strategically throughout our plant gave us power close to the load . . . conveniently, economically. Oil- and askarel-filled units were used where we needed high-impulse levels, while dry types were used when light weight, and ease of installation were key factors.

System flexibility with packaged control

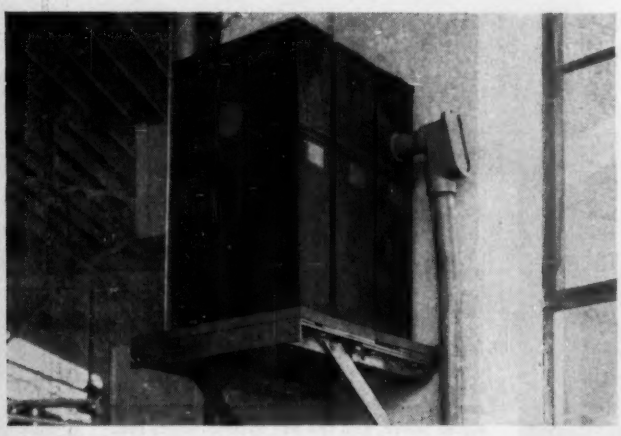
"Some of our machines were subject to frequent moving, so we used Westinghouse plug-in bus duct with individual controls at each machine. For our permanent arrangements, we used control centers for simplicity in planning and installation, a high degree of safety and flexibility, centralized operation and maintenance. In both cases, we found that Westinghouse packaged control equipment simplified system design, cut our costs up to 40%.

"Why not call Westinghouse . . . like I did?"

"I'm sure you'll find Westinghouse a real lifesaver in helping out with your plant power distribution systems, too. Their engineering team will gladly work with your staff and your consulting engineers. I got our plant on the road to electrical adequacy by getting in touch with my local Westinghouse representative."

For more information call your local Westinghouse sales office or send coupon. Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-96100-2



Westinghouse capacitors are low in initial cost, require no maintenance, save additional investment in transformer capacity. Solder-sealed porcelain bushings protect against leaks or contamination of dielectric.

WATCH WESTINGHOUSE!

COVER THE PRESIDENTIAL CAMPAIGN ON CBS TV AND RADIO!

Westinghouse Electric Corporation
3 Gateway Center, P. O. Box 868
Pittsburgh 30, Penna.

☐ I would like a showing of the 20-minute film, *Selecting the Right Industrial Distribution System.*

I'm interested in more information about:

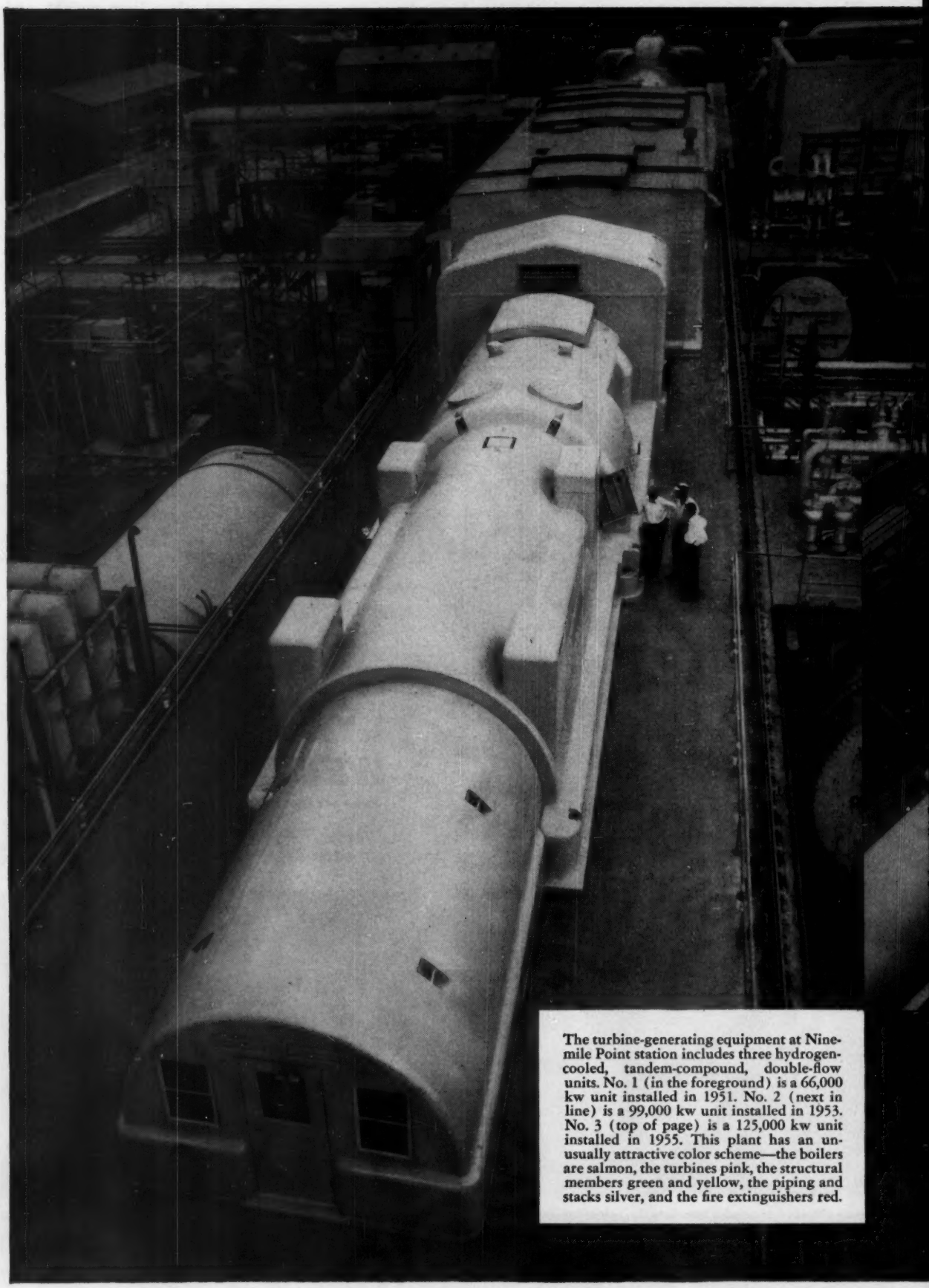
☐ Switchgear ☐ Capacitors
☐ Transformers ☐ Controls

NAME_____ TITLE_____

FIRM_____

ADDRESS_____

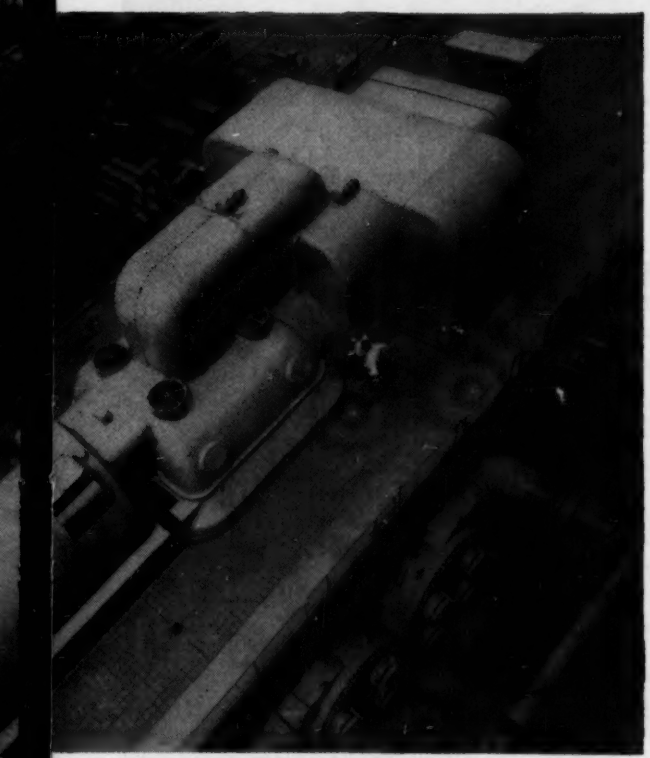
CITY_____ STATE_____



The turbine-generating equipment at Ninemile Point station includes three hydrogen-cooled, tandem-compound, double-flow units. No. 1 (in the foreground) is a 66,000 kw unit installed in 1951. No. 2 (next in line) is a 99,000 kw unit installed in 1953. No. 3 (top of page) is a 125,000 kw unit installed in 1955. This plant has an unusually attractive color scheme—the boilers are salmon, the turbines pink, the structural members green and yellow, the piping and stacks silver, and the fire extinguishers red.

Modern, efficient NINEMILE POINT plant uses the modern, efficient turbine oil:

GULFCREST



Close up of recently installed (1955) 125,000 kw turbine generator.

Pictured here are the turbine-generating units at the Ninemile Point station of Louisiana Power & Light Co., New Orleans, Louisiana, reported to be the most fully automatic utility power plant in the U.S.

For safe, sure, long-lasting protection of this key equipment, the lubrication is entrusted to Gulfcrest, the super-refined turbine oil.

After the base stock for Gulfcrest has gone through the usual steps employed in refining other turbine oils, it is processed by an extra refining step—the exclusive Gulf Alchlor Process—which produces a pure and stable lubricant that delivers unmatched performance.

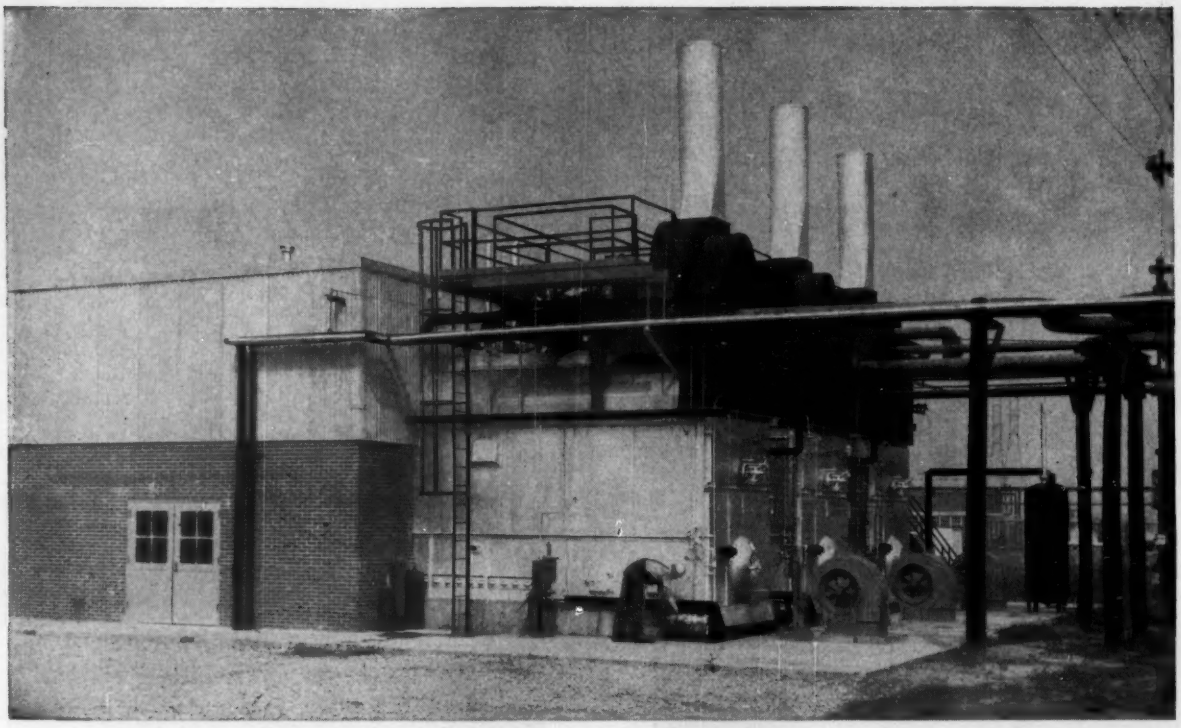
The next time you fill a turbine system, make it a fill for the finest, longest lasting protection by specifying Gulfcrest, the world's finest turbine oil. An experienced Gulf Sales Engineer will recommend the proper grade to meet your specific requirements.

Gulf Oil Corporation • Gulf Refining Company

1822 GULF BUILDING, PITTSBURGH 30, PA.

THE FINEST PETROLEUM PRODUCTS FOR ALL YOUR NEEDS

GULF



COMBUSTION CONTROLS GO OUTDOORS to help cut steam costs at American Synthetic Rubber Corporation's new packaged boiler plant near Louisville, Kentucky. The three 27,000 lbs./hr. gas or oil fired boilers operating at 175 psi generate steam for heating and processing.

"Big Station" Combustion Controls

Metering-Type Republic Control System Saves Fuel, Enables Boilers to Handle Fast Load Changes Quickly and Smoothly at American Synthetic Rubber Corporation

Peak combustion efficiency plus fast control of widely varying loads—these were combustion control requirements at American Synthetic Rubber Corporation's new packaged boiler plant near Louisville, Kentucky. To meet them, a metering-type combustion control system was specified instead of the "off-on" system usually furnished with packaged boilers. This system contains all of the basic control elements found in large installations and has all of the operating refinements common to large plants.

Is this metering-type control system worth its premium price? Flue gas tests made at various ratings conclusively answer the question with an emphatic YES. Combustion efficiency exceeds what similar packaged installations are delivering — and smoother operation is preventing chain-of-event troubles that frequently are caused by improper boiler operation. American Synthetic expects the controls to pay their extra cost in just a few years through fuel savings alone.

REPUBLIC FLOW METERS CO.

HOW METERING SYSTEM AT AMERICAN SYNTHETIC SAVES FUEL

Unlike most packaged boiler control systems, the Republic Combustion Control System at American Synthetic continuously measures both fuel and air inputs. Changes in fuel pressure, for example, which change the rate of fuel feed are detected immediately and automatically compensated for. Proper fuel-air ratio is maintained automatically at all ratings for maximum combustion efficiency.

Fast load changes are common in the plant with fluctuations varying as much as 8,000 lbs./hr. Rapid control response with Republic's dash-pot stabilization which prevents "hunting" enables boilers to meet new steam demands quickly and smoothly. Steam pressure and draft are held constant even during changing loads by the controls.

CONTROL SYSTEM CHANGES WITH FUEL

On oil firing, the controls operate on a steam flow-air correction system. For safety on gas firing, the controls are transferred to an air flow-gas flow correction arrangement which prevents over-firing in case air to the boilers is limited or blocked for any reason.

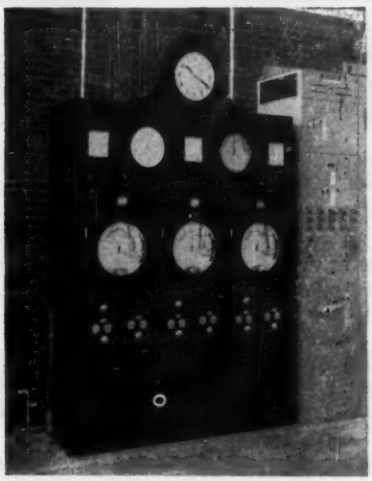
OPERATORS ARE ENTHUSIASTIC

The automatic correction feature of the Republic Controls eliminates time-consuming gas analysis and adjustments which would be necessary periodically with other types of controls. Correct operation of the boilers is easier, surer.

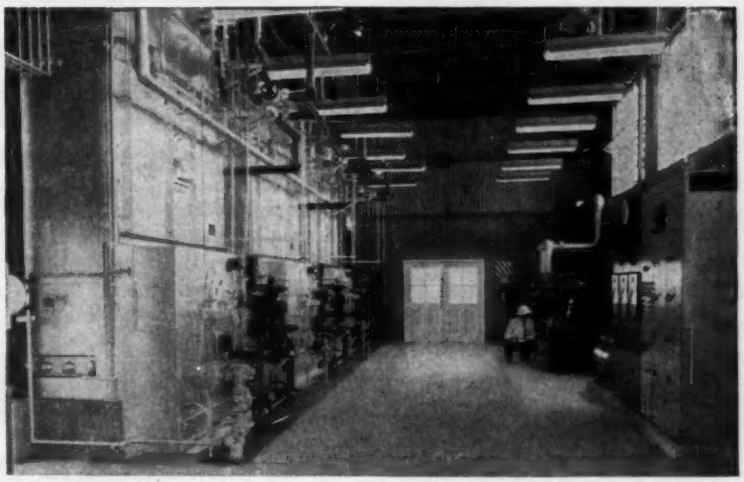
IF YOU ARE PLANNING ON INSTALLING PACKAGED BOILERS, find out how metering-type combustion control by Republic can improve efficiency, cut fuel costs and make operation simpler and easier. Contact your nearest Republic representative.

IF YOU ARE PLANNING *ANY* BOILER PLANT—any size, type or method of fuel firing — you can be sure of maximum efficiency with a Republic Combustion Control System engineered to exactly meet your needs. Write us when your problem is combustion control.

Pay Off for Packaged Boiler Plant



CENTRALIZED instrument and combustion controls on this Republic panel make checking and manual operation convenient and easy.

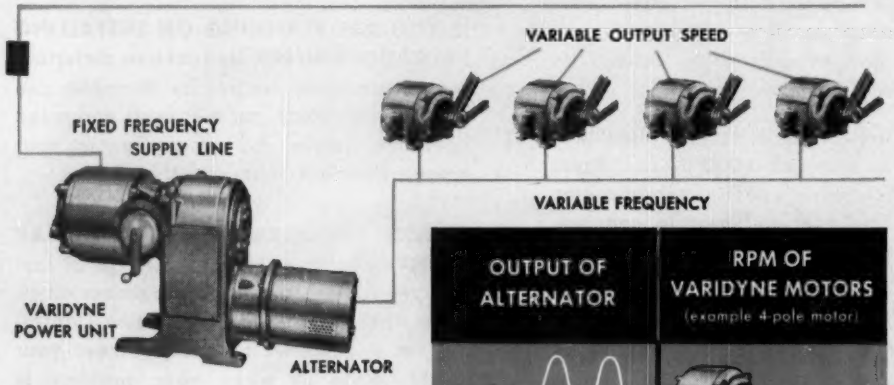


LOOKS EFFICIENT . . . AND IS. Interior view of the boilerhouse. All three boilers can be operated together or separately by means of control panel at right.

2240 Diversey Parkway • Chicago 47, Illinois

New Varidyne system...

Schematic of Coordinated Variable Speed System



OUTPUT OF ALTERNATOR	RPM OF VARIDYNE MOTORS (example 4-pole motor)
60 CYCLES	1800 RPM
30 CYCLES	900 RPM
120 CYCLES	3600 RPM

Now you can obtain variable speed from AC squirrel cage motors

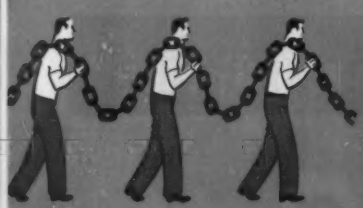
In this conveyor of the Dolly Madison Plant of Interstate Bakeries Corporation, a baker's dozen drive motors are used—13 U. S. double-reduction gearmotors. All are controlled to matched speed from the power unit.

HOW *Varidyne* WORKS

The principle of Varidyne is based on the fact that AC motors operate at a speed proportional to the frequency of applied power. As shown in the chart above, a 4-pole induction motor which normally operates at 1800 rpm on 60 cycles will operate at 900 rpm at 30 cycles, or 3600 rpm at 120 cycles. Because power lines operate at fixed frequency, AC motors operate at fixed speeds. The Varidyne system converts the fixed line frequency to a variable frequency by means of a Varidrive and alternator combination (power unit). This variable frequency is used to power one or more AC induction motors which then can be controlled simultaneously by regulating the power unit.

WHAT *Varidyne* CAN DO

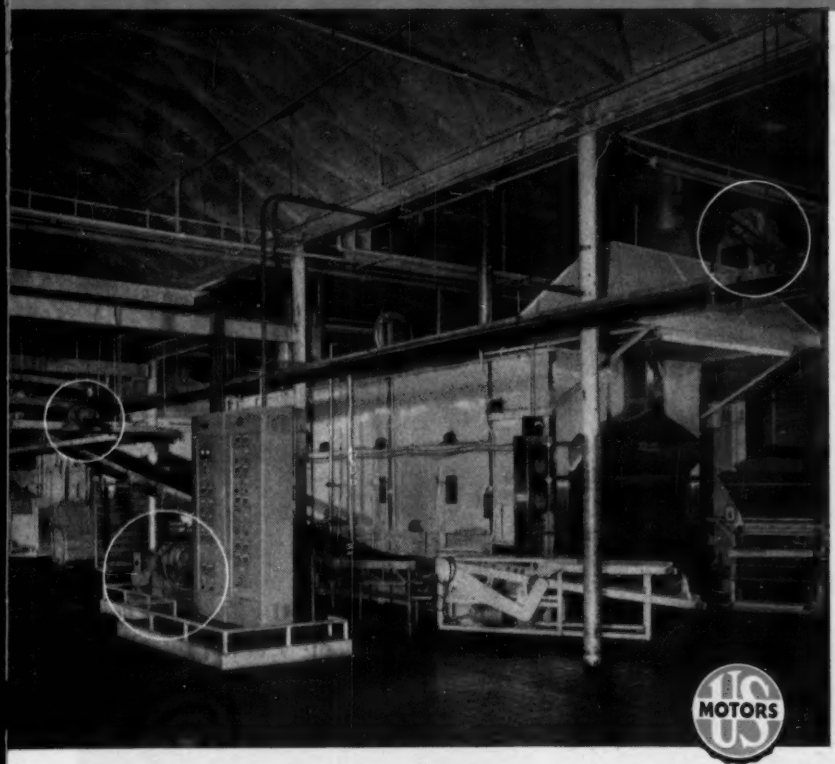
By the use of simple AC induction motors at the point of power application, Varidyne now provides the simplest and most dependable variable speed, multiple drive system obtainable. Motors of different speeds or types can be used in the same system and will change speed proportionately. Single motor systems can be supplied for applications with limitations of space, weight, temperature, vibration, etc. The rugged AC motors and circuitry of the system insure long trouble-free life, which reduces maintenance costs and eliminates special training for maintenance personnel.



EQUALIZED LOAD DISTRIBUTION *automatically* ACHIEVED

When the Varidyne motors are operating in tandem, as on a single conveyor, they will *equally* share the load. In earlier systems without equal load distribution, it was common practice to "overdesign" the conveyor with extra capacity motors, gears, chains and sprockets in order to withstand higher loads at any one point of the conveyor. Damage from extreme overloads was prevented by shear pins which caused frequent breakdowns and production interruptions. Varidyne motors eliminate this costly, troublesome practice.

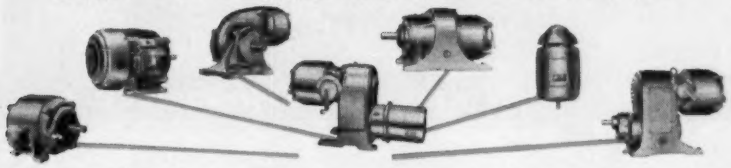
a simple means for simultaneous speed variations



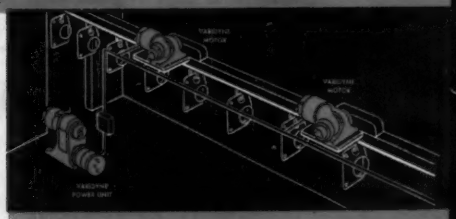
VARIABLE SPEED MULTIPLE DRIVES CAN NOW BE COORDINATED AND *automatically* CONTROLLED

Varidyne may be furnished with Varitrol pneumatic control, which operates *automatically* in response to a signal from the process or operation. The trouble-free operation of many Varidyne systems already in use has caused this new multiple drive system to be enthusiastically received throughout the nation. U. S. field engineers are prepared to give counsel and special service in applying Varidyne to meet your specific application.

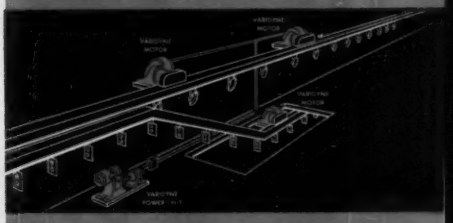
VARIDYNE OFFERS WIDE SELECTION OF MOTOR TYPES



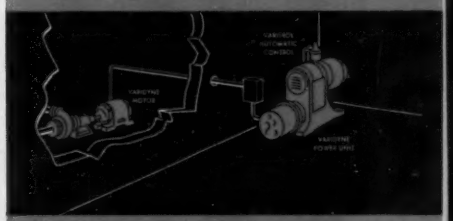
Selection of enclosure and speed range of Varidyne motors driven by the central Varidyne Power Unit is practically unlimited, including drip-proof, totally-enclosed and explosion-proof designs. Speeds of from 1 to 10,000 rpm are available in ratios of up to 5:1 and higher. Varidyne motors can be provided with integral gearing or with integral variable speed transmission for speed trimming. Varidyne motors can be furnished from ½ to 25 H.P. at maximum RPM. Power Units 1 to 50 H.P. connected load.



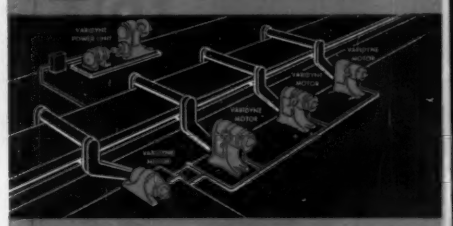
TANDEM MOUNTED DRIVES—The above example demonstrates two or more Varidyne motors driving a single conveyor. An important feature is the equal distribution of load between the Varidyne motors.



TWO MACHINES WITH PROPORTIONAL SPEEDS—Two or more machines or conveyors may be driven at same speed or at proportional speeds by a single Varidyne Power Unit.



SPECIAL CONDITIONS—One or more Varidyne induction motors meet special conditions such as restricted space, weight limitations, environmental hazards, etc., at the point of power application.



INDIVIDUAL DRIVE SPEED ADJUSTMENT—Varidyne motors with individual variable speed control can be used for trimming the speed within a system. The speed of the entire system can then be controlled simultaneously.

U.S. Electrical MOTORS

Send for free Varidyne bulletin

U. S. ELECTRICAL MOTORS Inc. P-9
P. O. Box 2058, Los Angeles 54, Calif., or Milford, Conn.

NAME_____

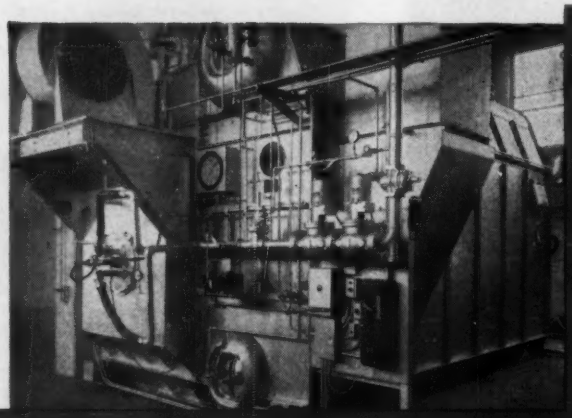
COMPANY_____

ADDRESS_____

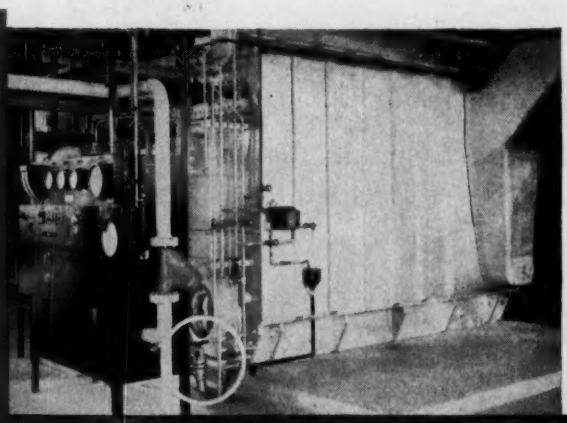
CITY_____ ZONE____ STATE_____

the blow-off valve trend on "package" boilers is

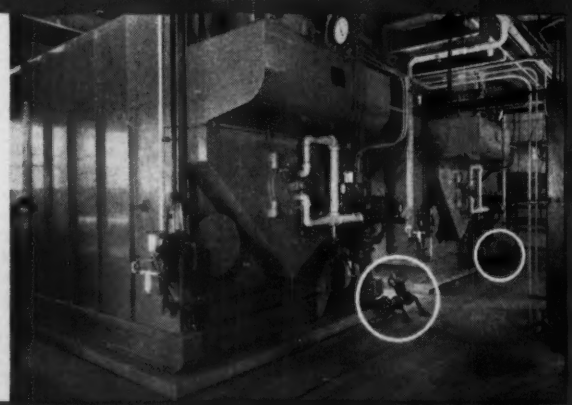
YARWAY SEATLESS



E. KEELER



COMBUSTION ENGINEERING



TITUSVILLE

KEWANEE-SPRINGFIELD

YARWAY® BLOW-OFF

■ More and more leading manufacturers of package-type boilers are featuring Yarway Blow-Off Valves on their units. Many are standardizing on Yarways.

The reason—good blow-off valves help good package boilers *perform better*.

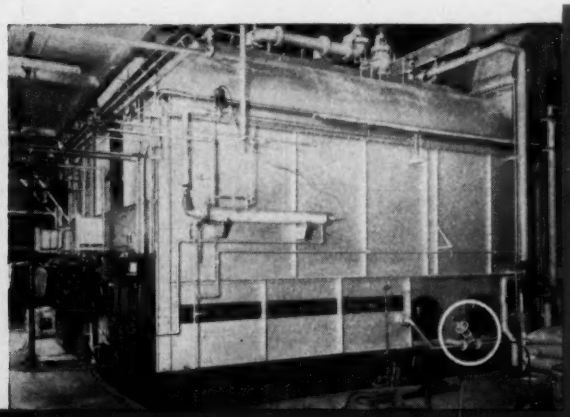
Yarway—known for nearly 50 years for *quality* blow-off valves—offers advanced design, dependable service, and reasonable cost . . . three features attractive to all boiler users.

The Yarway Seatless Blow-Off Valve, with balanced hollow sliding plunger and no seat to score, wear, clog or leak, is the most widely used valve for low and medium pressures.

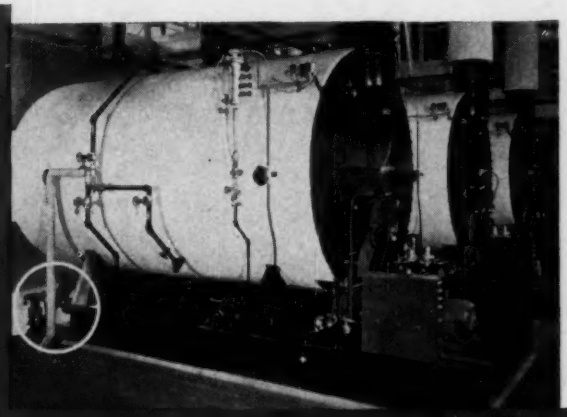
Specify Yarway Seatless Blow-Off Valves on your package boilers. All boiler makers will supply them.

For full description of Yarway Seatless Blow-Off Valves write for Yarway Bulletin B-426.

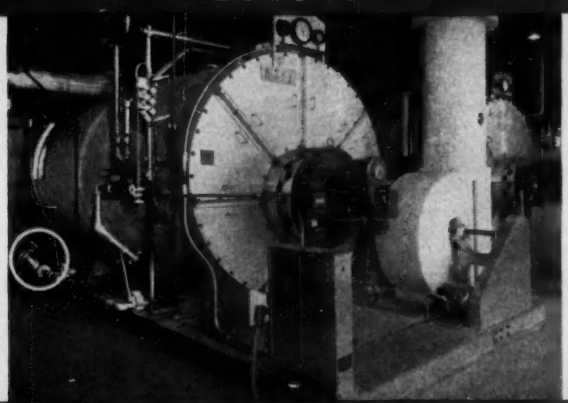
YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES



ERIE CITY



CLEAVER-BROOKS



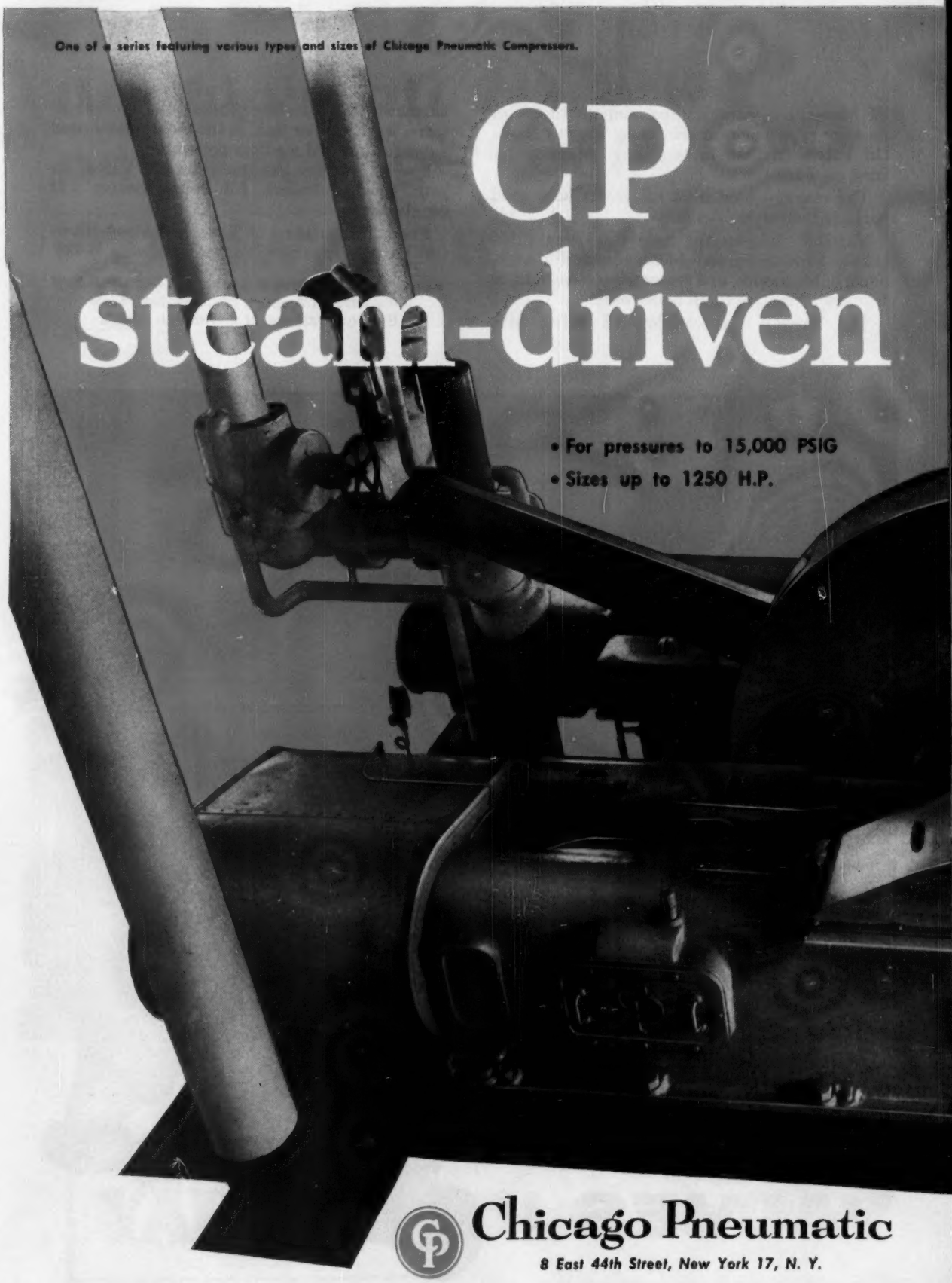
PREFERRED UTILITIES

● **Yarway Seatless Tandem Blow-Off Valve** (angle-straightway combination) with angle valve sectioned to show balanced sliding plunger design.

● **Yarway Seatless Tandem Blow-Off Valve,** angle-angle combination, straightway-angle or straightway-straightway tandems also available.

VALVES

One of a series featuring various types and sizes of Chicago Pneumatic Compressors.



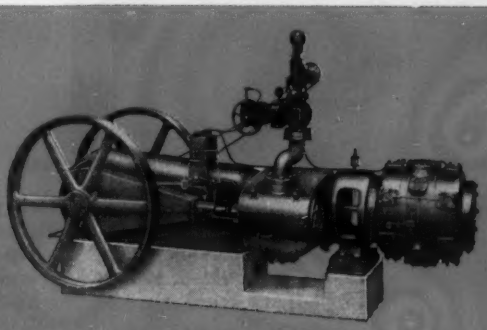
CP steam-driven

- For pressures to 15,000 PSIG
- Sizes up to 1250 H.P.

Chicago Pneumatic

8 East 44th Street, New York 17, N. Y.

AIR AND GAS COMPRESSORS • VACUUM PUMPS • PNEUMATIC TOOLS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS

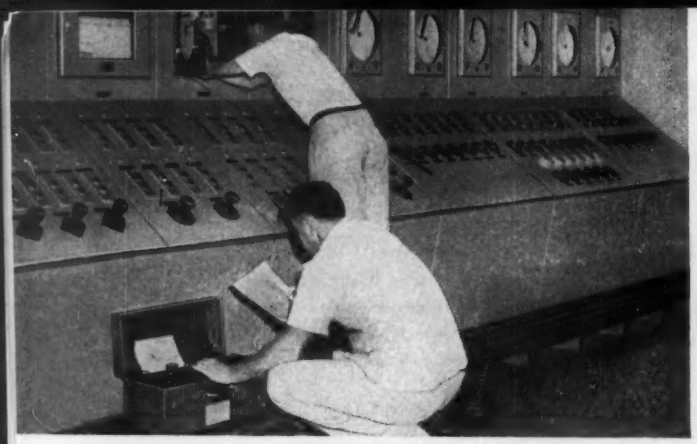


Class T single-stage, horizontal, straight-line, steam-driven compressor. Also available in two- and three-stage designs.

compressors

...for the process industries

Class H, four-corner, steam-driven, single-stage gas booster compressor.



Maintenance engineering

You can arrange to have a Honeywell service engineer visit your plant at regular intervals to inspect, clean, and adjust your instruments and controls. He's factory-trained and field-experienced in keeping good instruments in top operating condition. If an emergency should arise, a phone call will bring a Honeywell service engineer to your plant in a hurry.

Spare parts, in a rush

A Honeywell branch office near you can be your storeroom for standard parts . . . in addition, the Parts Depot in Philadelphia carries a complete stock of all normally used parts. With Honeywell stocking your spare parts, you save storage and inventory control costs. Most shipments are made within 24 hours after orders are received.

Service is the

Practical service training

The tuition-free Honeywell Training School teaches your instrument technicians the most up-to-date maintenance methods, fits them for the kind of problems they may encounter on the job. Intensive courses range from two to fourteen weeks.

Application engineering

Experienced Honeywell application engineers know your industry and processes. They design *complete* systems of instrumentation, reducing the work of your own engineering staff. From the broad Honeywell line, they recommend instruments that are exactly right for the job. And because Honeywell supplies all types of instruments, recommendations are made without bias. Service engineers will, if needed, help with installation and startup of your system.

big extra you get with Honeywell instrumentation

Honeywell offers you far more than instruments. You get service whenever and wherever you need it . . . service that begins when you first decide you need instruments, and continues long after they're installed. This service is always conveniently close at hand, for there are more than 110 Honeywell sales and service centers located strategically throughout the U. S. and Canada.

Prompt, competent service by nearby field specialists is an important plus-value of Honeywell instrumentation. Your local Honeywell sales engineer has all the facts on this service as it relates to your instrumentation needs. Give him a call . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

H HONEYWELL

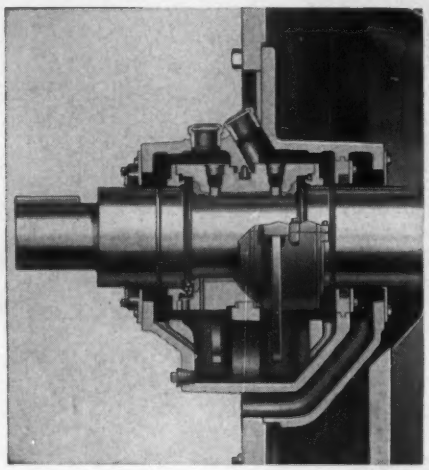
MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

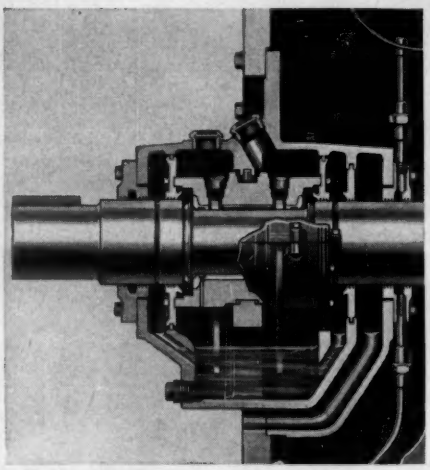
First in Controls

NEW Bearing Design Means Better Motor Performance

Allis-Chalmers capsule-type sleeve bearings now perfected for complete motor line



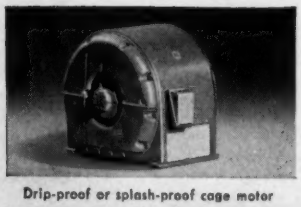
Standard capsule-type sleeve bearing



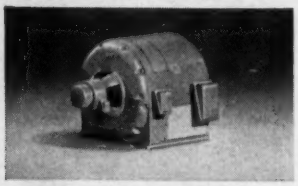
High speed capsule-type sleeve bearing

A new feature—an improved capsule-type bearing design—has been added to the Allis-Chalmers complete line of large end-shield bearing motors. This new bearing will give you better motor service, simplified maintenance and longer motor life through features like:

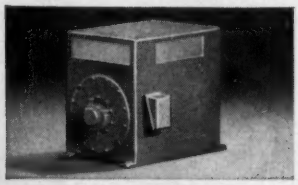
- Dust-tight, leakproof enclosure protects bearing from dirt, dust or abrasive materials.
- Venting system prevents oil leakage — keeps oil and vapor from getting into motor enclosure.
- Dual oil-rings insure bearing surface lubrication — either ring can adequately lubricate bearing.
- Split end-shield gives easy accessibility to winding and air gap — without disturbing capsule or bearing alignment.



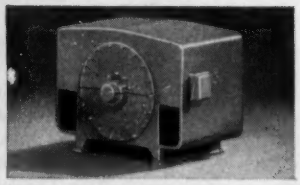
Drip-proof or splash-proof cage motor



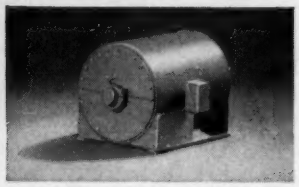
Synchronous or wound-rotor motor



High speed cage motor

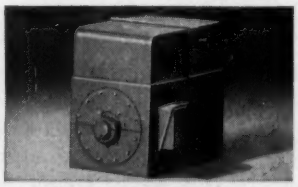


Weather-protected motor



Totally-enclosed fan-cooled motor

Totally-enclosed forced-ventilated motor



Water-cooled or inert-gas-filled motor

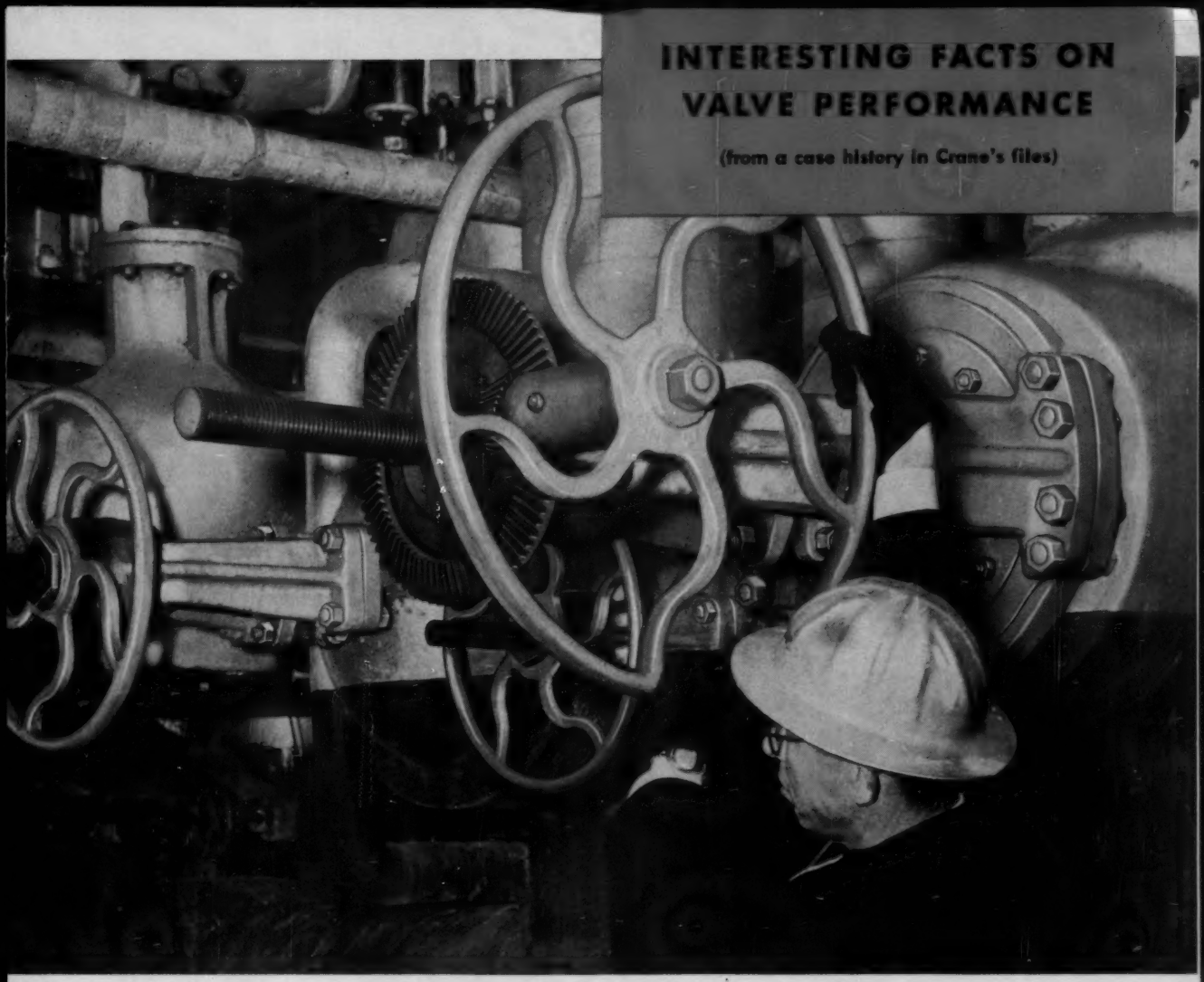
Capsule-type bearings are standard on these Allis-Chalmers motors.

You get **MORE** from Allis-Chalmers motors

More design and construction features — more application help. For complete information, contact your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-5032



12 years' cost-free service on saturated steam completed by this Crane valve

Since 1944, this early type Crane 16-inch Pressure-Seal gate valve has handled 450 psi saturated steam. It's working as a stop valve on a header in the Neches Butane Products Company's butadiene plant in Texas.

When opened for inspection recently—after 12 years of hard service—this rugged Crane valve was found to be in perfect condition. Not once has it leaked or needed maintenance at the bonnet joint or seat.

Instead of depending on bolting to retain pressure, the Crane Pressure-Seal bonnet design utilizes internal fluid pressure to make a leak-free, maintenance-free bonnet joint inside the body. Self-adjusting to temperature changes, the Crane flexible wedge disc completely eliminates sticking. Operation is always smooth and easy.

Besides giving such consistently dependable performance, Crane Pressure-Seal valves are extremely compact and streamlined.

They save on piping erection costs and simplify insulation. They're the first valves to consider for high-pressure, high-temperature power plant service.

Get all the facts from your local Crane Representative, or write to address below.

CRANE VALVES & FITTINGS
PIPE • KITCHENS • PLUMBING • HEATING

More Facts on These Valves
—See Next Page

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

For Power Service . . . Quality of known Quantity!

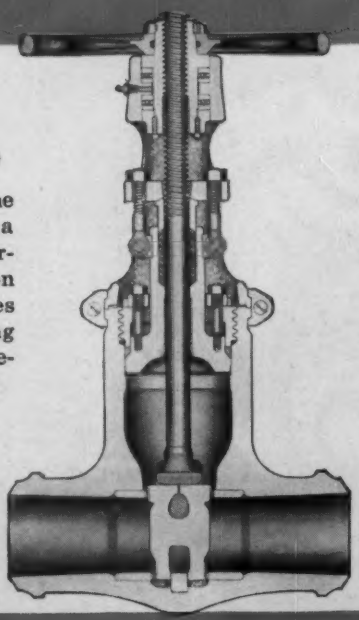
CRANE Pressure-Seal Bonnet Valves

with leak-free, maintenance-free bonnet joint

Here is quality in high-pressure, high-temperature valves that goes beneath the surface . . . quality you can measure by performance facts . . . quality that's born of Crane's 100-year leadership in flow control. Into these valves goes the skill of the pioneer in steel valve casting, combined with highest development of today's metallurgy. The same skill and care are applied in machining, assembly, testing, with Crane's unmatched facilities.

How CRANE Pressure-Seal is made

The bonnet joint is inside the valve. Sealing element is a wedge-shaped seal ring. Internal fluid pressure, acting on underside of bonnet, forces bonnet against the seal ring and body, forming a pressure-tight metal-to-metal joint.



Cross-section, 1500-Pound Gate, Butt-Welding Ends

GATE PATTERN

600, 900, and 1500-Pound and Higher Pressure Classes
Sizes up to 24 in.—Welding or Flanged Ends

Typical Features

Savings in weight and space up to 60% over conventional valves—with no loss of strength—with compact, streamlined design. Reduces piping erection costs; simplifies insulation.

Reduced turbulence and resistance to flow with improved straight-through flow design. Inner diameter of body seat rings and inside surface of disc guide are in line.

Smooth, non-sticking operation. Flexible wedge disc prevents pinching under contraction, even when valve is closed hot and opened cold. Operates easily with minimum torque.

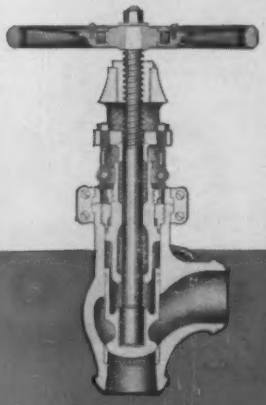
Choice of steels. Depending on service needs, body and bonnet are Crane Carbon-Molybdenum, or Chrome-Molybdenum Alloy Steels. Seating surfaces are Stellited. Body seat rings are welded and can't loosen in service.

GLOBE and ANGLE PATTERNS

1500-Pound—Sizes up to 4 in.—Butt or Socket-Welding Ends

Like the gate valves, these patterns feature extreme compactness, weight and space saving, smooth body lines. The Y-Pattern globe body permits interior designing for decreased flow resistance and turbulence. Disc is wide-bearing plug-type, and piston guided. Body seats are integral, Stellited, as is disc. Packing gland is Crane ball type, self-equalizing.

Cross-Section, 1500-Pound Globe, Butt-Welding Ends



Cross-Section, 900-Pound Angle Stop-Check

STOP-CHECK VALVES—GLOBE and ANGLE PATTERNS

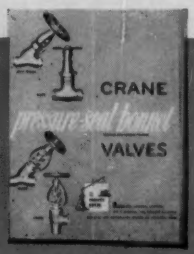
900, 1500-Pound, and Higher Pressures—Sizes up to 12 in.—Butt-Welding Ends

The big feature of these valves—in addition to leak-free, maintenance-free Pressure-Seal bonnet joint—is their unusually low pressure drop rating, with low resistance to flow.

Outstanding flow regulation is achieved with patented Crane pressure-equalizing design that automatically controls lift and speed of action of disc in direct relation to steam flow conditions.

THIS BOOKLET TELLS ALL

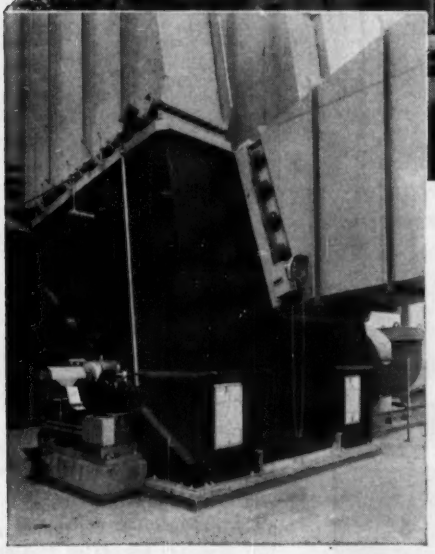
. . . about these modern valves for high-pressure, high-temperature service . . . how they give improved flow control . . . how they reduce your piping maintenance costs. Ask your local Crane Representative for a copy of Circular AD-1936, or write to Crane Co., Chicago 5, Ill.



THE CINCINNATI GAS & ELECTRIC COMPANY INCREASES ITS CAPACITY

— SPECIFIES "BUFFALO" INDUCED DRAFT FANS

Walter C. Beckjord Generating Station, Unit No. 3, Cincinnati Gas & Electric Company, where dependable induced draft by "Buffalo" helps supply power for this well-known utility's growing list of customers.



"Buffalo" I. D. Fan at Walter C. Beckjord Generating Station, Unit No. 3. Note heavy, reinforced construction of inlet boxes and housing. Inlet dampers provide instant, positive draft control to match load. Heavy-duty self-aligning bearings are water-cooled. Fan wheels and housings are engineered to resist effects of heat and erosion.

ADDITIONAL "BUFFALO" FANS ORDERED FOR ANOTHER UNIT TO START UP IN DECEMBER 1957

The Cincinnati Gas & Electric Company, pushing through its ambitious program of expanded service, specified "Buffalo" I. D. Fans for both this new Unit No. 3 station and Unit No. 4 which will be operating in 1957.

Selection of "Buffalo" by leading utilities for many, many years is your assurance of dependable, economical draft service. In fact, the "Buffalo" Mechanical Draft Fan you specify embodies the best of our 79 years of fanmanship — peak endurance, peak efficiency for its job — in other words, the "Q" Factor* that's built into every "Buffalo" Fan. You'll be interested in our new, improved lines of forced and induced draft fans — write for engineering data today!

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

BUFFALO FORGE COMPANY

BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

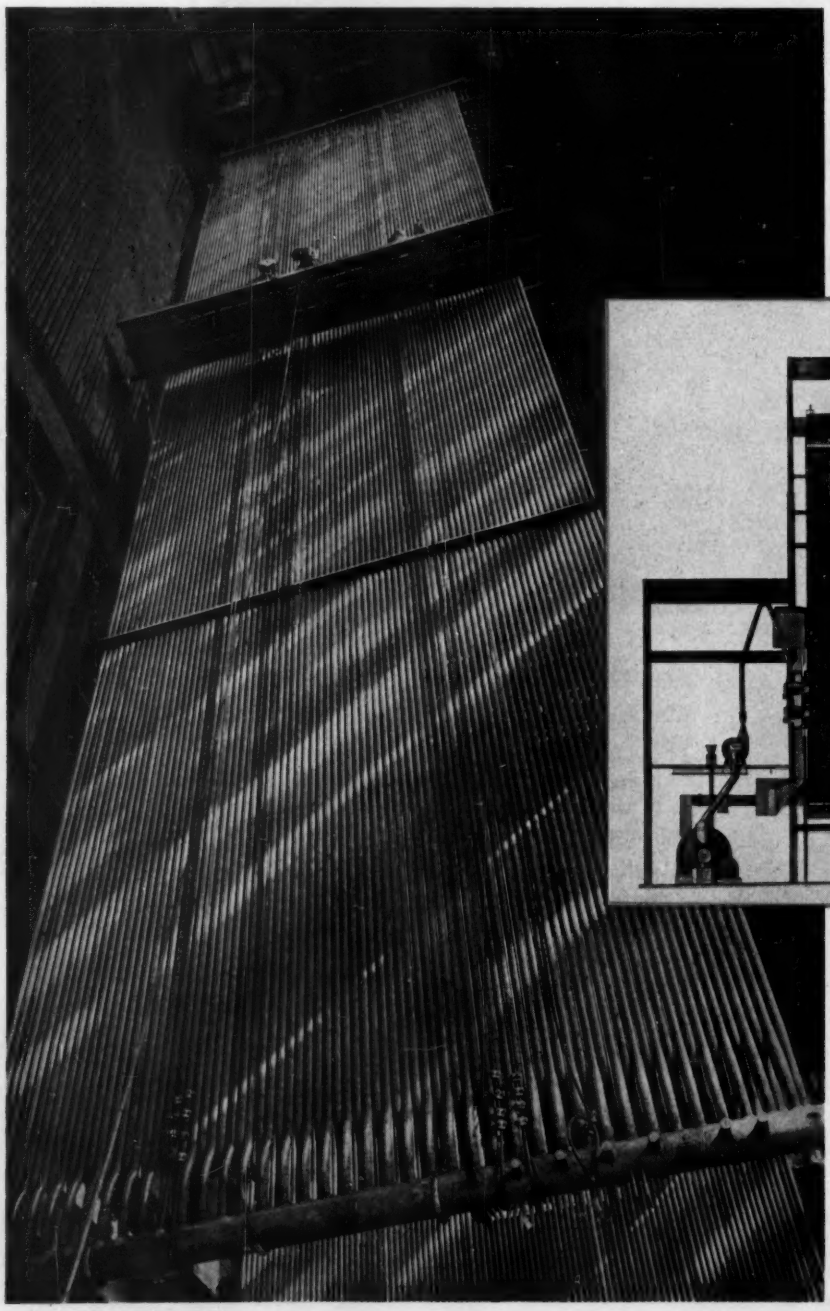
"Buffalo"

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

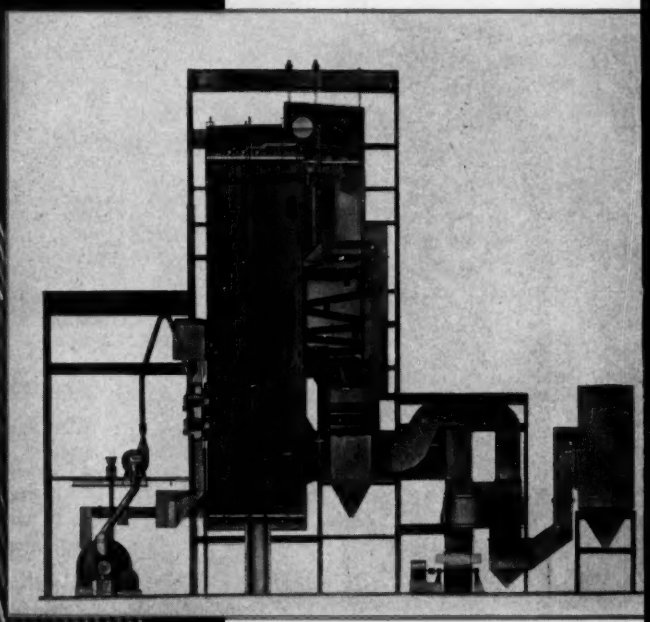
Second "outdoor type" FW steam

LOW LOAD FACTOR

installed at new



Prefabricated at the job site, panel construction of furnace side-waterwalls, radiant superheater and division waterwall made possible significant savings in steam generator construction costs.



Cross-section of Martins Creek No. 2 steam generator, designed for continuous rated capacity of 1,200,000 lbs/hr at 1325 psig normal, 955F. Divided furnace, combination radiant and convection superheater, two continuous loop economizers, weatherproofed outdoor type.

generator, designed for

and QUICK START-UP

Martins Creek Steam Electric Station

Built for "below zero" winter conditions, No. 2 unit raises capability of this modern steam generating plant of Pennsylvania Power & Light Company to 320,000 kw.

UNLIKE most new steam generators that are installed for base load operation, with peak loads being carried on older, less efficient units, the new No. 2 Foster Wheeler steam generator at Martins Creek is intended at the beginning to operate at only 20 to 40 per cent capacity.

Like the No. 1 FW steam generator at this station, it is a peak load unit. It has the requisite control facilities so that it quickly can help meet the early morning demand present in the PP&L system. For these heavy load periods, it provides the desired additional capacity economically, at minimum total annual cost — the major portion of the power being provided by other stations of the system where the delivered fuel cost is appreciably lower.

The eleventh FW unit now serving the Pennsylvania Power & Light Company, this Martins Creek steam generator has an 8-hour-peak capacity of 1,300,000 lbs/hr at 1325 psig, 955F at the superheater outlet. Final steam temperature is held constant at all loads from 325,000 lb per hr to full load. Of the single drum, nonreheat type, it supplies steam to a turbine generator with a nameplate rating of 132,500 kw. Two Foster Wheeler ball mill pulverizers furnish bituminous coal to twelve 30-inch FW intervane burners.

View looking south showing Pennsylvania Power & Light Company's new Martins Creek Steam Electric Station.

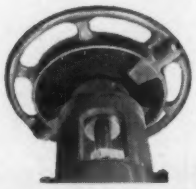
Backed by more than 50 years' experience in power plant equipment pioneering, steam generators by Foster Wheeler assure efficient, dependable performance at low overall cost. Whatever your requirements, it will pay you to consult us. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

FOSTER WHEELER

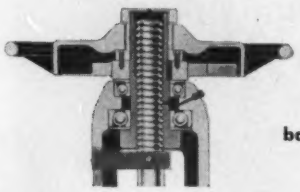
NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

You Get SPECIAL Features in

THESE ARE EDWARD FIRSTS!

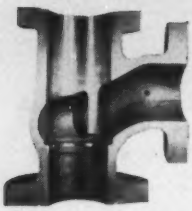


IMPACTOR* HANDWHEEL
Permits closing torque up to 2.8 times more than is possible with ordinary handwheel.

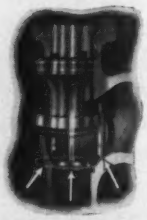


EVALTHRUST* YOKE BUSHING
Patented ball bearing construction for easy valve operation.

CLOSURE INDICATORS
No guessing if valve is tightly closed for either regular operation or for special tests.



LOW PRESSURE-LOSS BODY CONTOURS
Both globe and angle bodies let maximum flow through. Pioneered by Edward. Copied but never bettered.



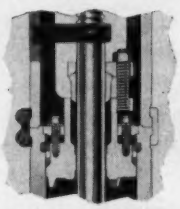
THREE-POINT GUIDING
Streamlined, cored out guide ribs, integral with body, keeps disk in alignment. Dangerous stem guiding eliminated.

SELF-CENTERING DISK THROTTLING LIP
Avoids jamming or cocking, assures tight seating. prevents wire-drawing.

*Registered trade names of Edward Valves, Inc.

FREE FLOATING TUBULAR DISK-PISTON
Quicker opening, surer closing, flow tested for less pressure loss.

EQUALIZER*
Original design. Gives higher, surer piston lift, lowers pressure loss, eliminates wear-producing vibration.



EDWARD PRESSURE-SEAL DESIGN
First pressure-seal non-return valves were built by Edward. Pressure-sealing parts do not guide floating disk-piston, insuring a permanent seal.

INTEGRAL SEATS
Hard facing applied directly to valve body competely eliminates possibility of leaks behind screwed or welded-in seat rings.

These are also Edward Firsts!

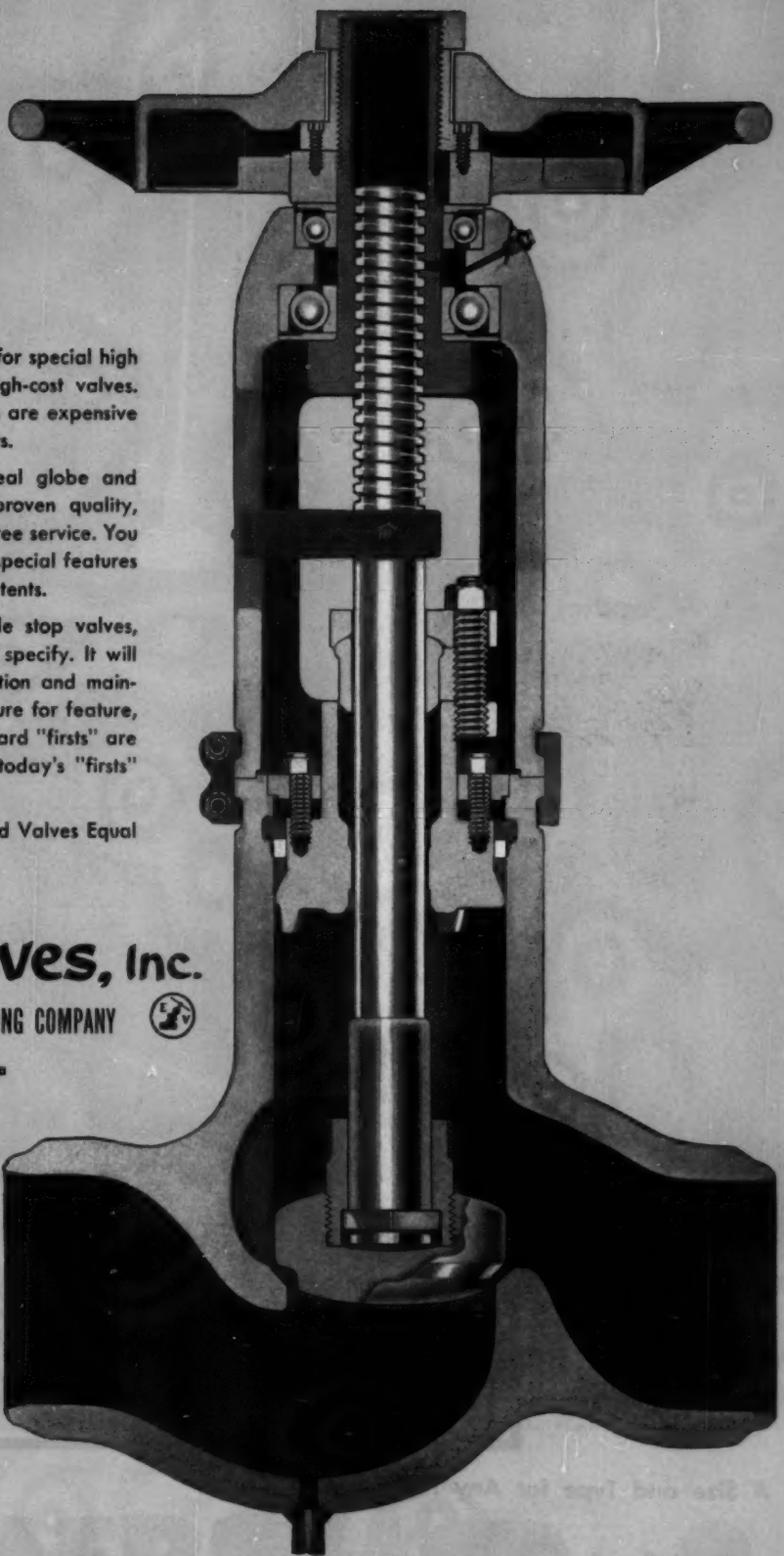
Evalized* plating of valve parts for wear and corrosion resistance . . . Patented welded-bonnet Univalves* . . . Impactor* handles for small valves . . . Seat located guide ribs in gate valves . . . No-bonnet instrument valve construction . . . Stellited welded-in seats . . . Hour-glass type disk-piston . . . EValpak* packing . . . Separated feedline stop-check valves . . . Screwed and welded flanges for forged steel valves . . . Swing bolt retaining washer construction, and

***Patented Interchangeability of Stop, Check and Non-Return Valves* . . . Greatest possible valve flexibility for your plant!**

ROCKWELL-BUILT Edward VALVES

STANDARD Edward Valves

Don't Settle For Less or Pay More



Special high pressure applications call for special high pressure valves but not necessarily high-cost valves. Many of the Edward standard features are expensive "specials" for most valve manufacturers.

When you buy Edward Pressure-Seal globe and angle stop valves, you are buying proven quality, proven dependability, proven trouble-free service. You are buying standard valves with many special features that are exclusive and protected by patents.

Next time you need globe or angle stop valves, investigate Edward valves before you specify. It will pay you dividends in reduced installation and maintenance costs to compare Edward, feature for feature, with other valves. Many of the old Edward "firsts" are now industry standards and many of today's "firsts" will be industry standards tomorrow.

Always specify Edward. Only Edward Valves Equal Edward Quality and Performance.

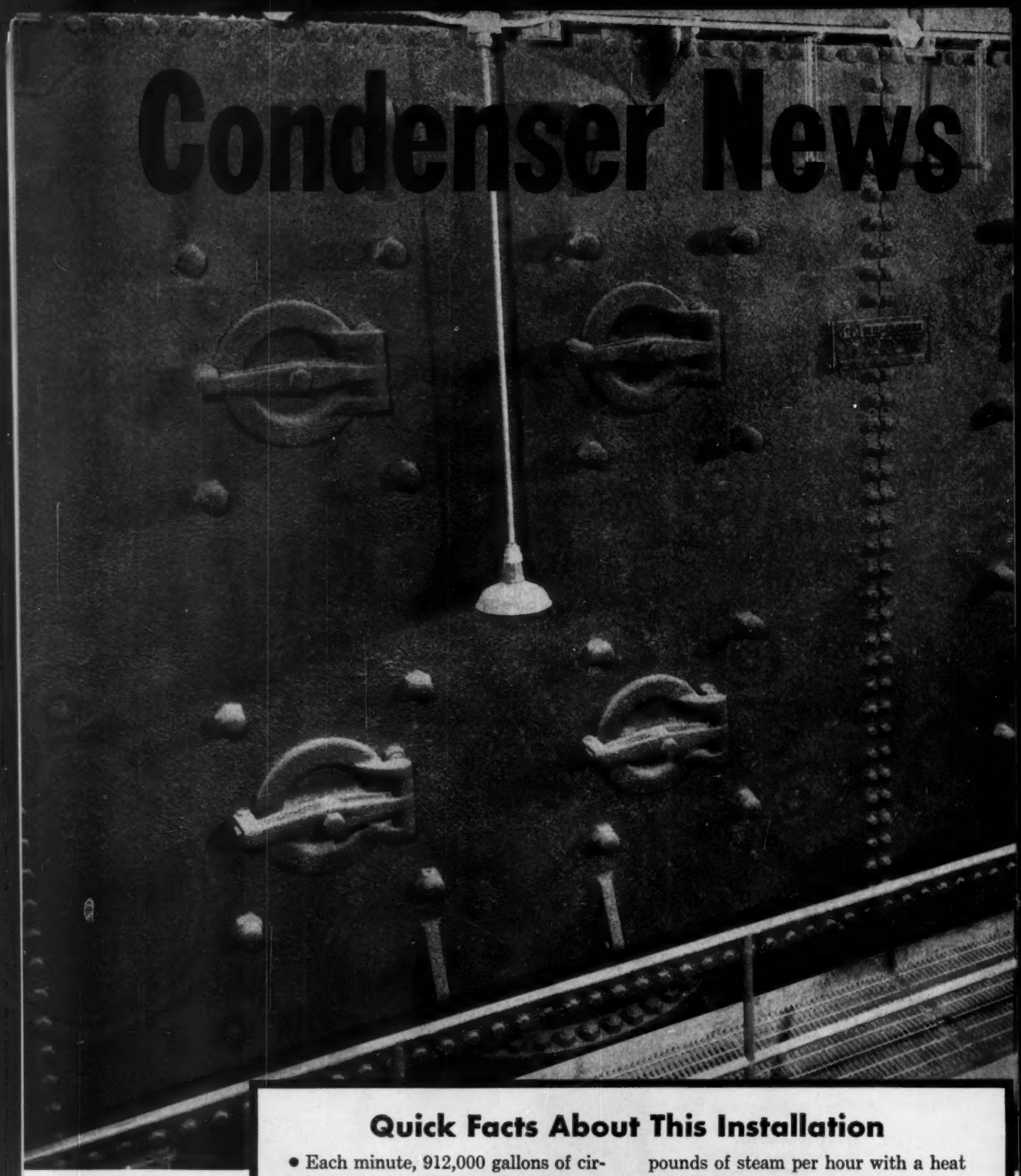
Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

1230 West 144th Street, East Chicago, Indiana

Typical Edward Pressure-Seal globe stop valve design for 900, 1500, or 2500 lb. service at 1000 F.

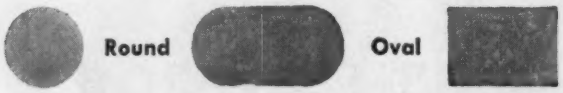
Another Product



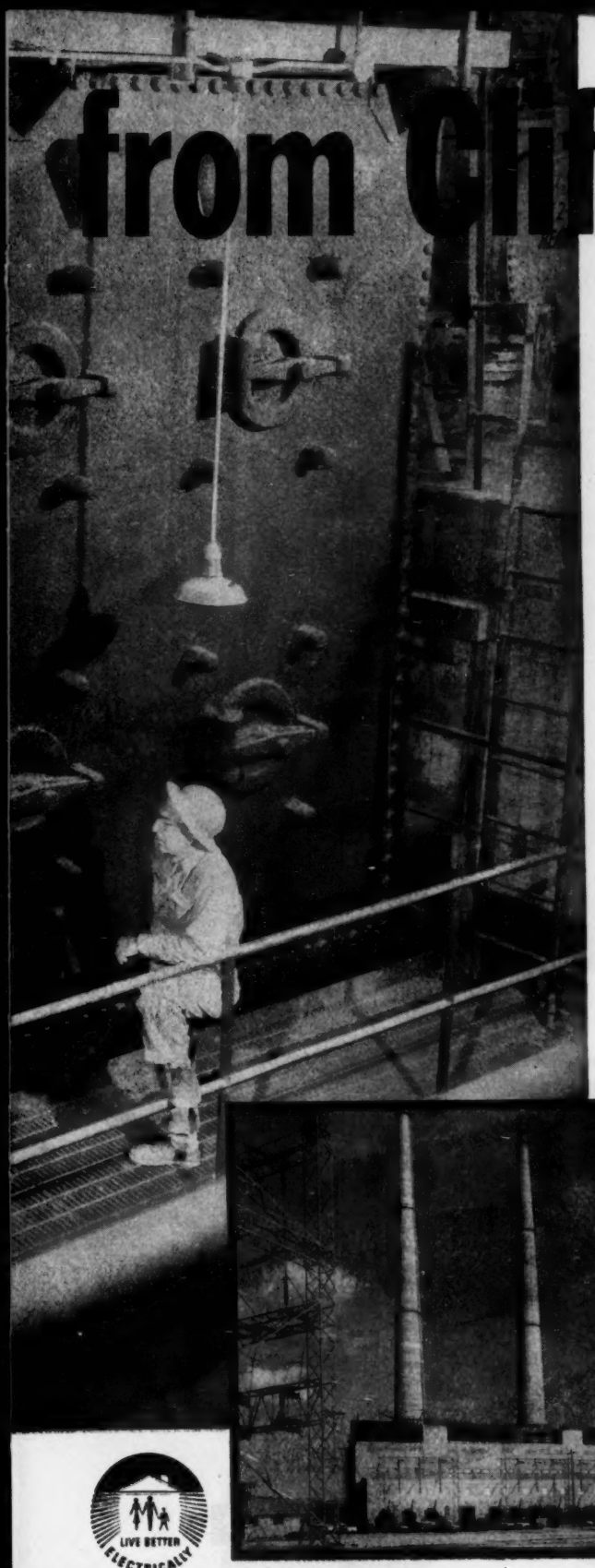
Quick Facts About This Installation

- Each minute, 912,000 gallons of circulating water will be used in the condensers . . . enough for a city of approximately 8,750,000 people.
- Each condenser will handle 979,000 pounds of steam per hour with a heat rejection rate to water of 930 million Btu per hour.
- About 500 miles of tubing went into the six 100,000-sq-ft condensers.

A Size and Type for Any Need



ALLIS-



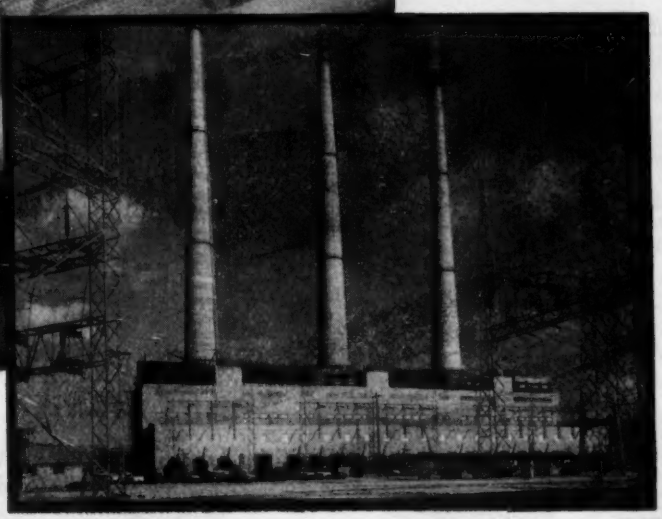
from Clifty Creek

World's Largest Investor Owned Generating Plant Completes Installation of Sixth Allis-Chalmers Condenser

More power for the Atomic Energy Commission! Giant Clifty Creek Plant, with a capacity of 1,290,000 kilowatts — more than that of Hoover Dam — is the largest power plant ever built by private enterprise.

Just completed, Clifty Creek is one of two major steam plants built by the Ohio Valley Electric Corporation to supply the electric power requirements of AEC's tremendous new Portsmouth (Ohio) atomic plant. Clifty is located on the Ohio River at Madison, Indiana. OVEC is sponsored by 15 private utility companies of the Ohio Valley region.

Six 100,000-sq-ft, single-pass Allis-Chalmers surface condensers serve the Clifty Creek Plant's six 215,000-kw steam turbine-generator units.



Condensers of Unusual Design

Multi-steam-path design is a feature of each condenser. This unique A-C design makes *all* tubes completely effective from one end to the other by directing steam to even the most remote sections of the condenser.

The result is high vacuum, high condensate temperature and good deaeration . . . in other words, high operating efficiency.

Get Information

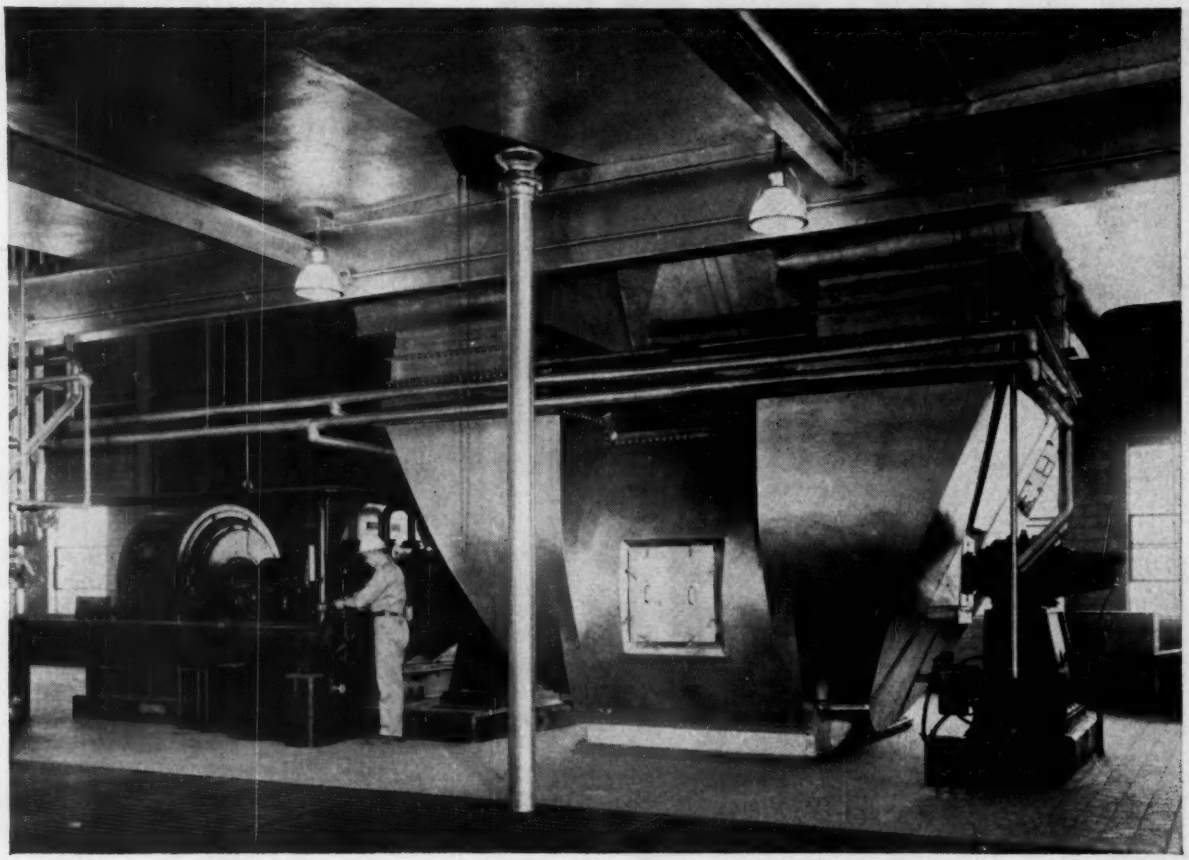
For information about Allis-Chalmers multi-steam-path design, contact your nearest A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin. A-5038

LIVE BETTER ELECTRICALLY

CHALMERS

A-C ALLIS-CHALMERS

American Blower Mechanical Draft

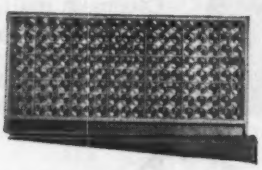


American Blower Induced Draft Fans meet the rigid requirements of modern power plants, where maximum pounds of steam are constantly produced at peak efficiency. Here are a few of the many features they offer:

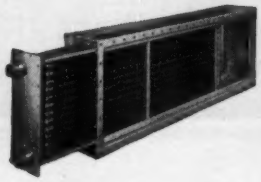
- High static efficiency, low R.P.M.
- Minimum boiler "outage"
- Certified ratings, minimum maintenance
- Minimum space requirements

To meet your exact specifications and ensure reliable performance, American Blower mechanical draft equipment is accurately formed and welded, fan rotors are perfectly balanced and tested, and all final assemblies are minutely inspected.

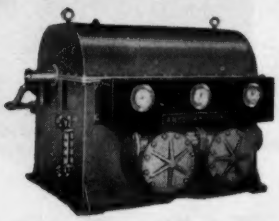
Other American Blower Heavy-Duty Equipment for Power Plant Applications



Collectors and precipitators for dust and fly ash control



Heavy-duty steam coils for high-pressure duty



Gyrol Fluid Drives for boiler feed pump and fan control

Fans meet peak-efficiency standards

American Blower Forced Draft Fans are suitable for either indoor or outdoor installations. Each type of fan is carefully developed and its performance-rating guaranteed. Here are some of the reasons why American Blower Forced Draft Fans are widely accepted by power plants throughout the nation:

- Certified ratings
- Heavy reinforced housings and wheel-shaft assembly designed with first critical well above maximum operating speed
- Special streamline inlets designed for all wheel types to obtain high efficiency
- Choice of bearings to fit any application

If your plans include mechanical draft equipment—for new installations or as replacements—consult your American Blower sales engineer. He can give you helpful information on job-fitted American Blower equipment to meet your power plant requirements. Call our nearest branch office or write: American Blower Corporation, Detroit 32, Michigan. In Canada, look for Canadian Sirocco products.

AMERICAN BLOWER

Division of American-Standard

First
Research-Cottrell
"Double-Deck"
Fly Ash Precipitator

Space was a big problem in this installation at the Burlington Generating Station of Public Service Electric and Gas Company of New Jersey. Two integral combination mechanical-electrical precipitators, large enough to handle 600,000 cfm of gas from Boiler No. 7, had to be squeezed into the smallest possible ground area.

If a conventional side-by-side arrangement had been used, these two units would have required about 1,700 square feet. By "stacking" the two combination precipitators, one on top of the other, Research was able to cut this space requirement by 50% — a saving of 850 square feet.

Although this arrangement had never been attempted with Research fly ash precipitators, Research knew from their experience with more than 500 central station Cottrells that it could be done. Guaranteed for 97% collection efficiency, these Burlington Generating Station units were placed in operation in October, 1955.

Perhaps you, too, have a knotty problem that demands a more creative approach — backed up by experience with over 500 fly ash precipitators. Whether you require a straight precipitator or a combination unit, at Research-Cottrell you can be sure of the most economical solution to your problem.

Other Research-Cottrell Precipitators at Public Service Electric and Gas Company of New Jersey

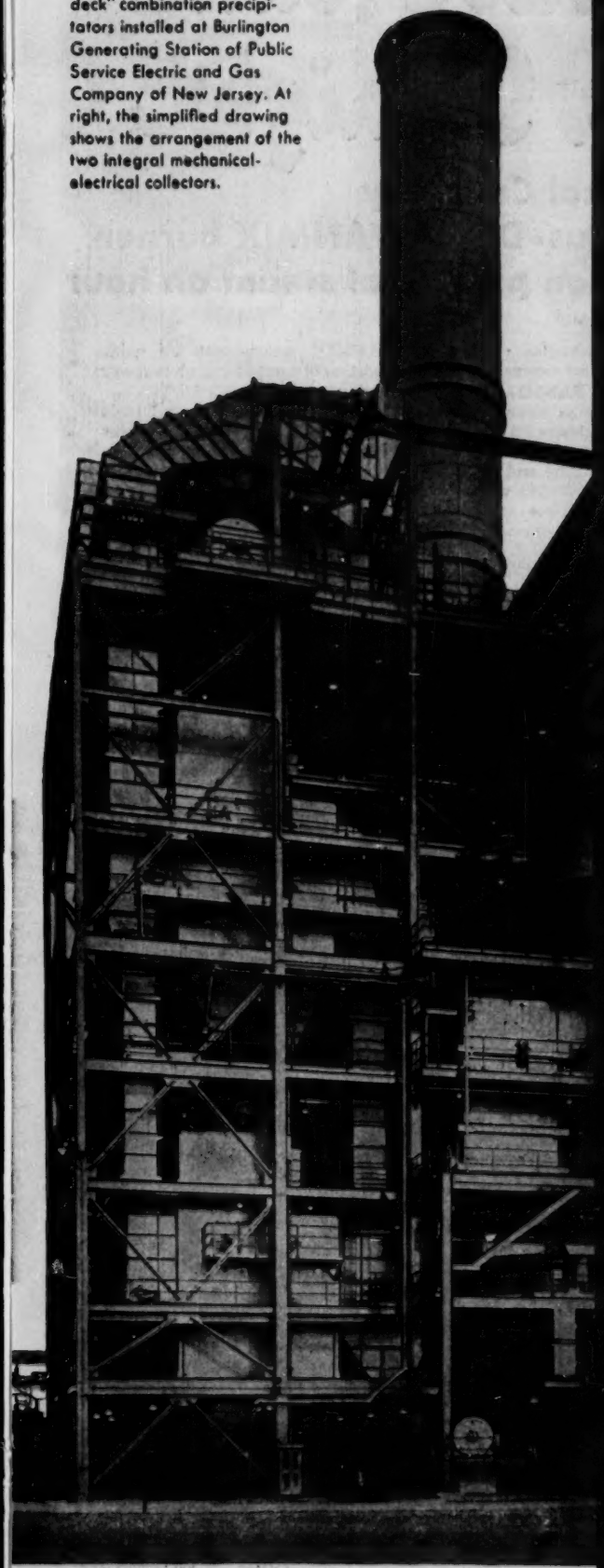
Installation Date	Generating Station	Boiler Number	Number of Pptrs.	C. F. M.
1937	Burlington	11	1	270,000
1939	Essex (Newark)	25 and 26	4	520,000
1940	Burlington	12 and 13	2	448,000
1941	Marion (Jersey City)	51 and 52	2	448,000
1942	Burlington	14 and 15	2	448,000
1946	Kearny	1 (Mercury Unit)	1	160,000
1947	Essex (Newark)	1	3	390,000
1955	Burlington	7	2*	600,000
		Total	17	3,274,000

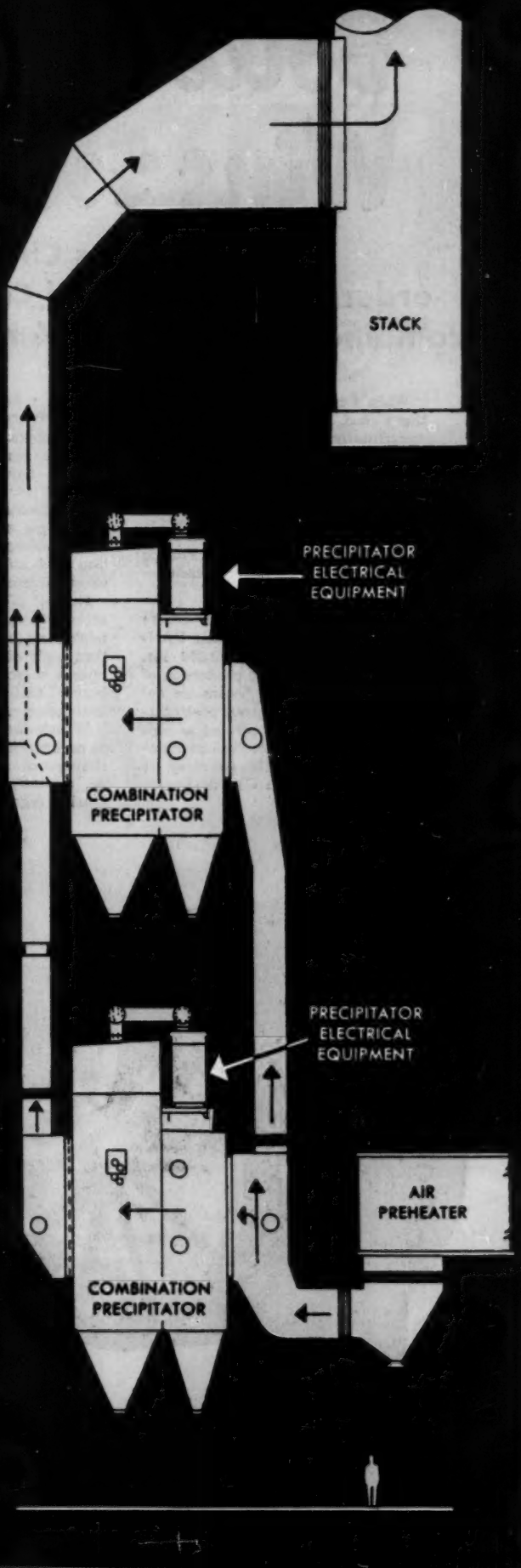
*"Double-Deck" Arrangement

Research-Cottrell, Inc.

Main Office and Plant: Bound Brook, New Jersey • 405 Lexington Ave., New York 17, N. Y.
Grant Building, Pittsburgh 19, Penna., 228 No. La Salle St., Chicago 1, Ill. • 111 Sutter Bldg., San Francisco 4, Cal.

Research-Cottrell's "double-deck" combination precipitators installed at Burlington Generating Station of Public Service Electric and Gas Company of New Jersey. At right, the simplified drawing shows the arrangement of the two integral mechanical-electrical collectors.





Boiler-Burner Team Wins Seven Straight

Phillips Chemical Company orders Vogt boiler and Coppus-Dennis FANMIX burner combinations to make 1¾ million pounds of steam an hour

When a customer praises a product, that's fine. But when a customer *continually re-orders*, that's conclusive proof of user-satisfaction.

Phillips Chemical Company, Borger, Texas — producer of synthetic rubber — first installed Henry Vogt boilers with FANMIX burners back in 1943. As plant production increased, Phillips again purchased the same equipment — in 1946, and again in 1951.

Today, a total of 7 Vogt boilers equipped with Coppus-Dennis FANMIX burners provide 1,750,000 lbs. steam each hour for the production of synthetic rubber. The boilers are designed for 250,000 lbs. steam peak operation but have been operated as high as 275,000 lbs. per hour. Their performance is typical of the efficiency of boilers equipped with Coppus-Dennis FANMIX burners.

FANMIX • Better Combustion • Better Efficiency • Higher Ratings

All Coppus-Dennis FANMIX burners — for gas as well as combination gas-oil — have the exclusive FANMIX action. Their *revolving orifices* give violent mechanical mixing and agitation of gas and air, therefore causing instantaneous and complete combustion with *minimum excess air* (5% excess air is not unusual).

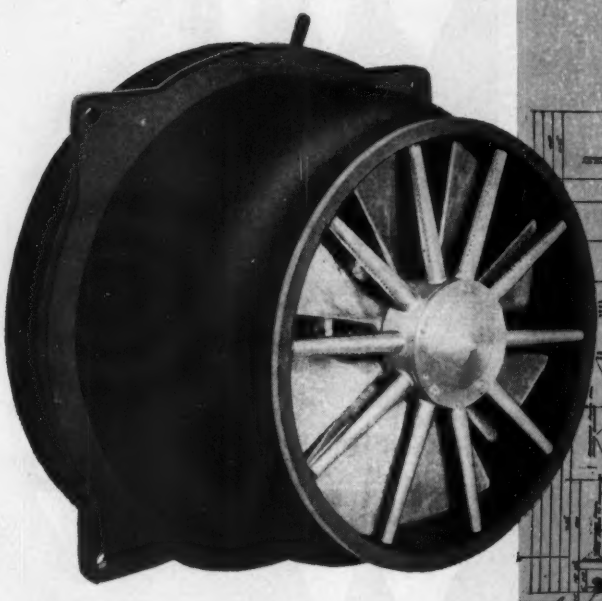
Because of this exclusive FANMIX action, furnace space is not required for mixing and *higher boiler ratings* are thus easily obtained. The burners also have a shorter flame than any other burner and will not cause flame impingement.

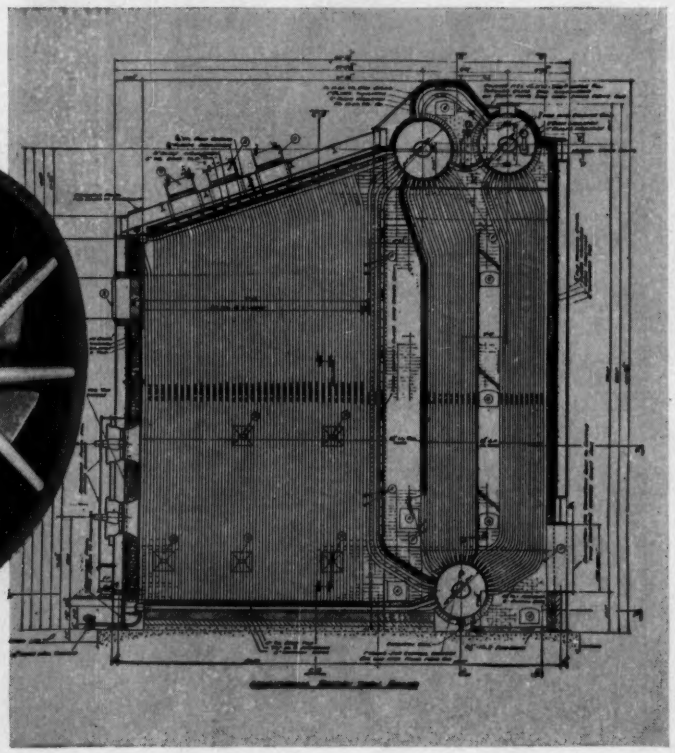
What's more, by incorporating a *fan* as an integral unit, FANMIX burners have *no draft loss* across the burner. As a result, increased ratings are possible regardless of draft conditions.

FANMIX action, with its quick completion of combustion, gives *lower* exit temperatures.

If you are not using Coppus-Dennis FANMIX burners in your present boiler, why not plan now to take advantage of the exclusive FANMIX action? You need no forced draft equipment, increase in stack or increase in furnace volume for FANMIX operation. And you get increased capacity. When specifying FANMIX on *new* boilers, you can plan on reduced combustion space, higher ratings, less stack height or reduced induced draft capacity — and, of course, *no* forced draft equipment.

For further information, mail coupon today. Sales offices in *Thomas' Register*. Other "Blue Ribbon" Products in *Chemical Engineering Catalog, Refinery Catalog, Best's Safety Directory* and *Mining Catalogs*.





JET REACTION is utilized to rotate fan which is integral part of burner. Ideal mixture for fast, complete combustion and peak efficiency is caused by automatically proportioned high velocity air passing at right angles through fuel.

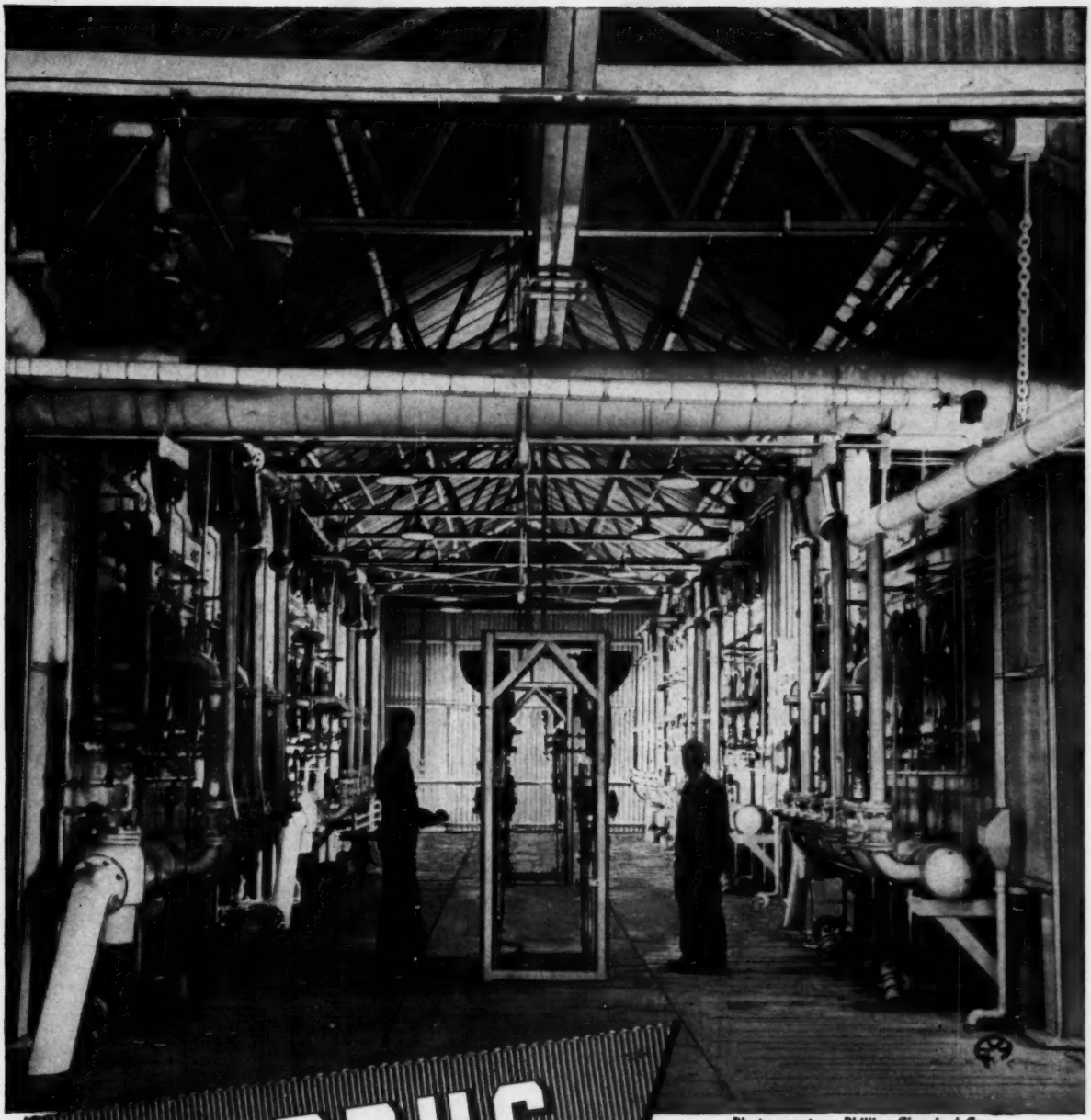


Photo courtesy Phillips Chemical Co.

HENRY VOGT BOILERS are here shown installed in the Phillips Chemical Company, Borger, Texas. Boilers use Coppus-Dennis FANMIX burners.

SEND COUPON for further information. Coppus engineers FANMIX burners to your individual requirements.

PLEASE ATTACH THIS COUPON TO YOUR COMPANY LETTERHEAD

COPPUS ENGINEERING CORPORATION
169 Park Avenue
Worcester 2, Massachusetts

Please send complete data on Coppus-Dennis FANMIX Burners. I'm particularly interested in ☐ gas ☐ combination gas-oil.

Name.....Title.....

Company.....

Address.....

City.....Zone.....State.....

ERIE CITY STEAM

The 650 Acre Fortier Plant of American Cyanamid on the Mississippi River near New Orleans, Louisiana

THIS $50,000,000 PLANT

Processes Natural Gas, Air, Water and Sulphur to produce a variety of Petrochemical Products, most important of which is Acrylonitrile, basic to farm and industry

Dependability is the keystone of petrochemical processing, and that is why we are proud to have Erie City steam generators selected for this important operation. Cyanamid's Fortier Plant gets its natural gas from the abundant Louisiana oil fields, its water from "ole man river" and its process steam from three Erie City 200,000 lbs./hr. steam generators.

Erie City has over forty years experience with 2-drum boilers gained in hundreds of installations. The basic 2-drum design, pioneered by Erie City, has been modified in a compact design to incorporate a completely water cooled furnace as an integral part of the main circulation system. Heavy refractory furnace linings are thus eliminated and continuously high ratings can be carried. Erie City 2-drum boilers permit wide flexibility, quick response to load changes and produce steam of high quality.

Erie City designs and manufactures all major components of its broad line of steam generators and offers undivided responsibility. For concise information about the complete line, ask for Bulletin SB-50P.

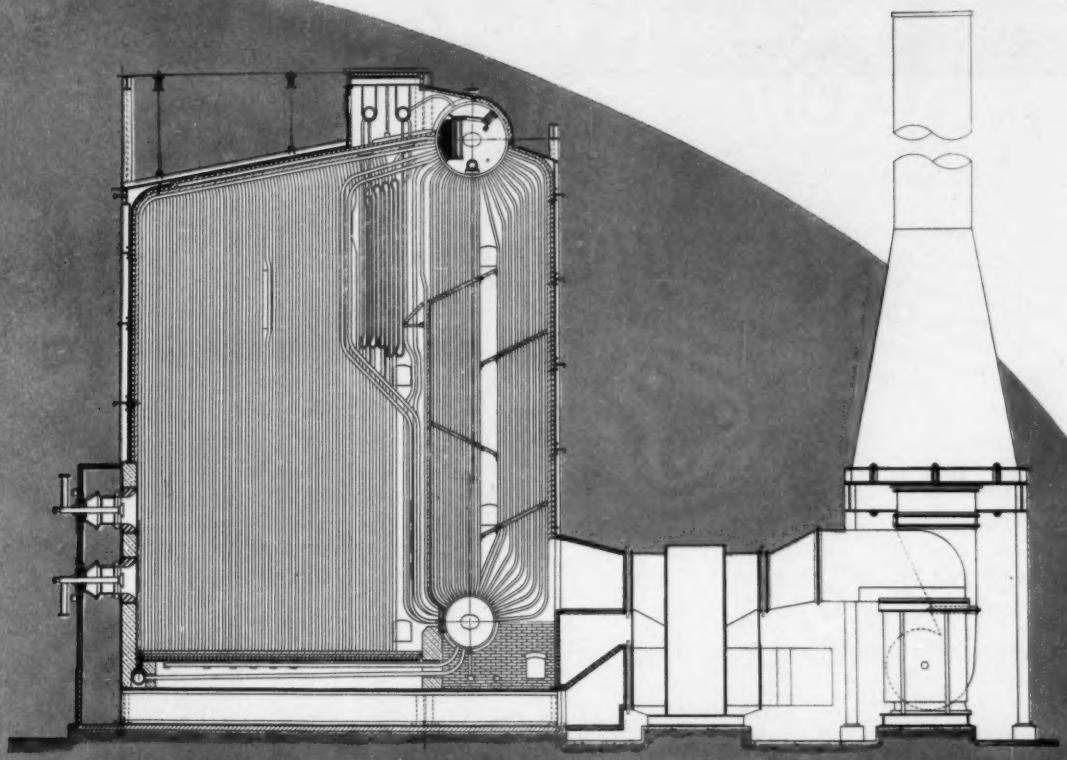
ERIE CITY
176 Years in Steam Generation

You can depend on Erie City for sound engineering

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

- - - powers processing at FORTIER PLANT, New Orleans, La.



BOILER DATA:

BOILERS—2-DRUM

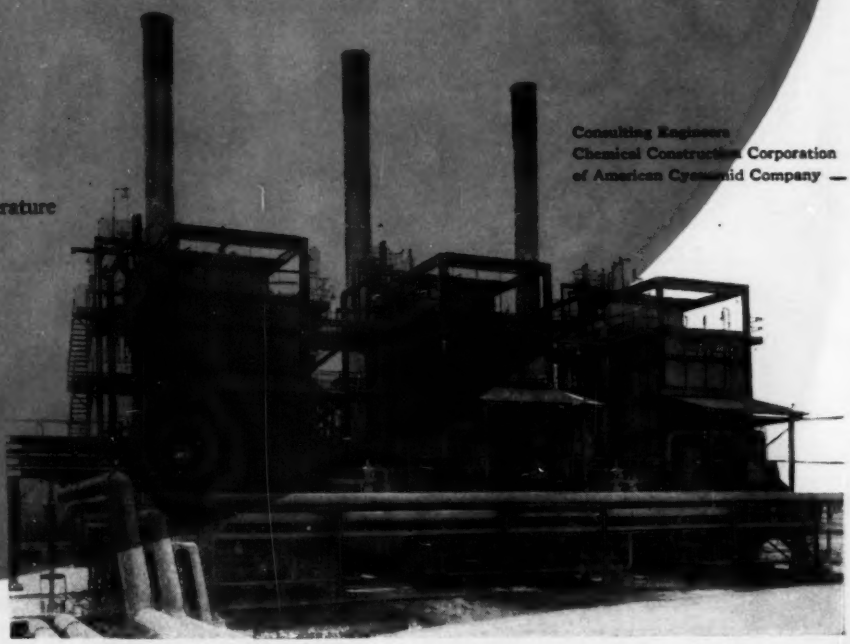
3 Erie City~

200,000 lbs./hr.

- Design Pressure
  700 psig
- Total Steam Temperature
  750° F.

SUPERHEATERS—

F. C. PENDANT



Consulting Engineers
Chemical Construction Corporation
of American Cyanamid Company —

YOU CONSERVE POWER INCREASE EFFICIENCY REDUCE MAINTENANCE

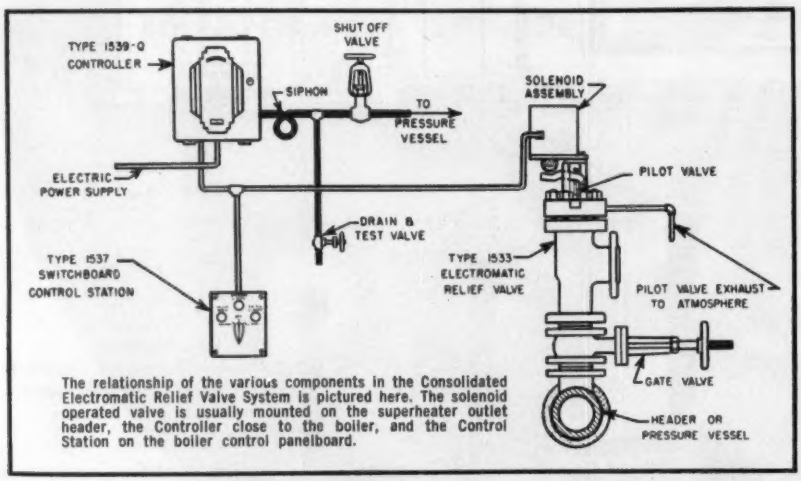
WITH THE CONSOLIDATED "ELECTROMATIC" RELIEF VALVE

The ideal auxiliary valve for steam generating plants with pressures to 2500 psi and temperatures to 1100° F., the Consolidated Electromatic Relief Valve relieves pressures precisely within close limits with "quick as a wink" cyclic action. It's an automatic, electrically actuated valve that can be accurately set for a differential of 1% or less between the opening and closing pressures.

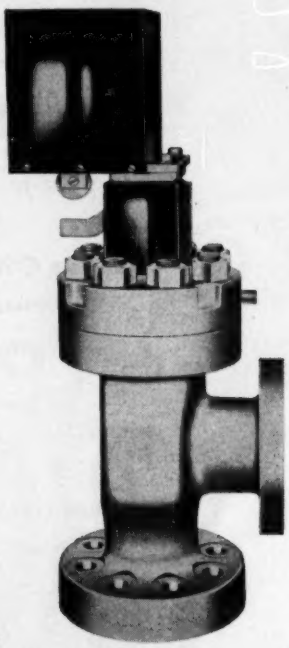
Operated by a solenoid actuated by a control station mounted in the panelboard, merely setting the switch provides automatic or manual service or cuts the valve out of operation. High superheat temperatures or other variables do not affect valve operation. A constant pressure output is maintained on the superheaters.

The Electromatic is also used to purge superheaters during start-up or as a superheater surge vent valve to reduce substantially the possibility of damage to equipment.

Wherever the Electromatic supplements spring-loaded safety valves, power is conserved, the efficiency of steam generating equipment is increased and maintenance is reduced. The Consolidated Electromatic Relief Valve is available in these sizes: 2½", 4", 10" and 14". Get complete specifications and operational details. Send for Bulletin 720.



The relationship of the various components in the Consolidated Electromatic Relief Valve System is pictured here. The solenoid operated valve is usually mounted on the superheater outlet header, the Controller close to the boiler, and the Control Station on the boiler control panelboard.



In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario.

CONSOLIDATED SAFETY VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, CONSOLIDATED SAFETY VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

CONSULTING ENGINEERS: SARGENT AND LUNDY

G-E progress in cross-compound design offers

MORE ECONOMY FOR TODAY'S HIGHER RATINGS

Keeping pace with today's demands for higher ratings and greater efficiencies are General Electric developments in cross-compound turbine-generator design. This design separates high- and low-pressure sections, permitting greater efficiency in each. Latest G-E cross-compound designs offer better economies than ever before obtainable.

An application of this design is Unit No. 2 (above), now in operation in the Will County Station of the Public Service Company Division, Commonwealth Edison Company. Located near Chicago, the Will County Station is an important power producer for Northern Illinois.

This installation typifies the vigorous efforts being made by progressive electric utility companies to expand and improve the efficiency of their power generation systems to provide adequate low-cost electricity for increasing loads.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Now G-E design of cross-compound

LOW-PRESSURE SECTION (front) with 38-inch last-stage buckets carries 40% of unit's total load and operates at 1800 rpm. Low-pressure (about 80 psig) and low-temperature (560 F) steam enters opposite ends of section, flows towards center. Steam exhausts downward to condenser through a single condenser opening. Low speed allows use of large, efficient last-stage buckets and liberal exhaust hoods—two features vital to the efficient performance of higher-rated turbines operating at low-exhaust pressures.

HIGH-PRESSURE SECTION (rear) of opposed-flow design carries 60% of unit's total load and operates at 3600 rpm. Steam enters in the center, flows to the left (or front), exhausts downward. Reheated in the boiler, it re-enters turbine adjacent to initial steam entry, flows to the right, exhausts to crossover pipes leading to low-pressure turbine. This design permits admission of both initial and reheat steam near the center of the high-pressure casing, thus concentrating high temperatures in a small area.

units brings new high in efficiency

Longer last-stage buckets in low-pressure section give maximum efficiency

The 1800 rpm speed of the low-pressure section permits the use of longer last-stage buckets which provide greater efficiency at low exhaust pressures. On a 250,000 kilowatt cross compound unit, for example, this can mean a saving of as much as 50 million pounds of coal per year.

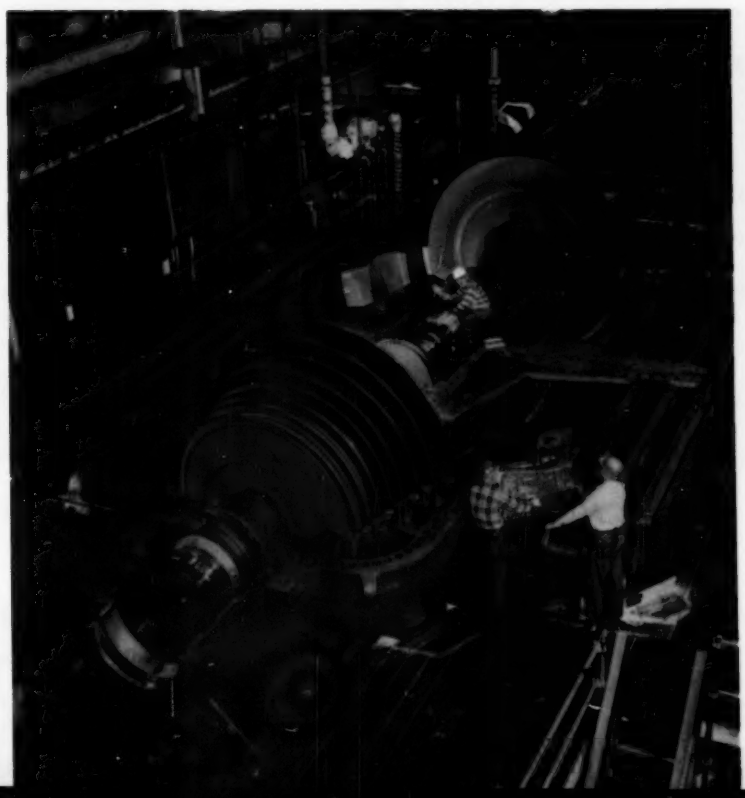
In the 3600 rpm high-pressure section, General Electric's opposed-flow design avoids severe temperature gradients with resulting thermal distortion by concentrating all high-steam temperatures in one small area of the casing. This design and the use of special high-pressure, high-temperature parts has resulted in outstanding efficiency.

Because there are two sections, each is comparatively short—a feature helpful in making more compact station arrangements. In fact, some designs of cross-compound units can easily be fitted into extensions of existing stations which cannot accommodate other designs of equal rating.

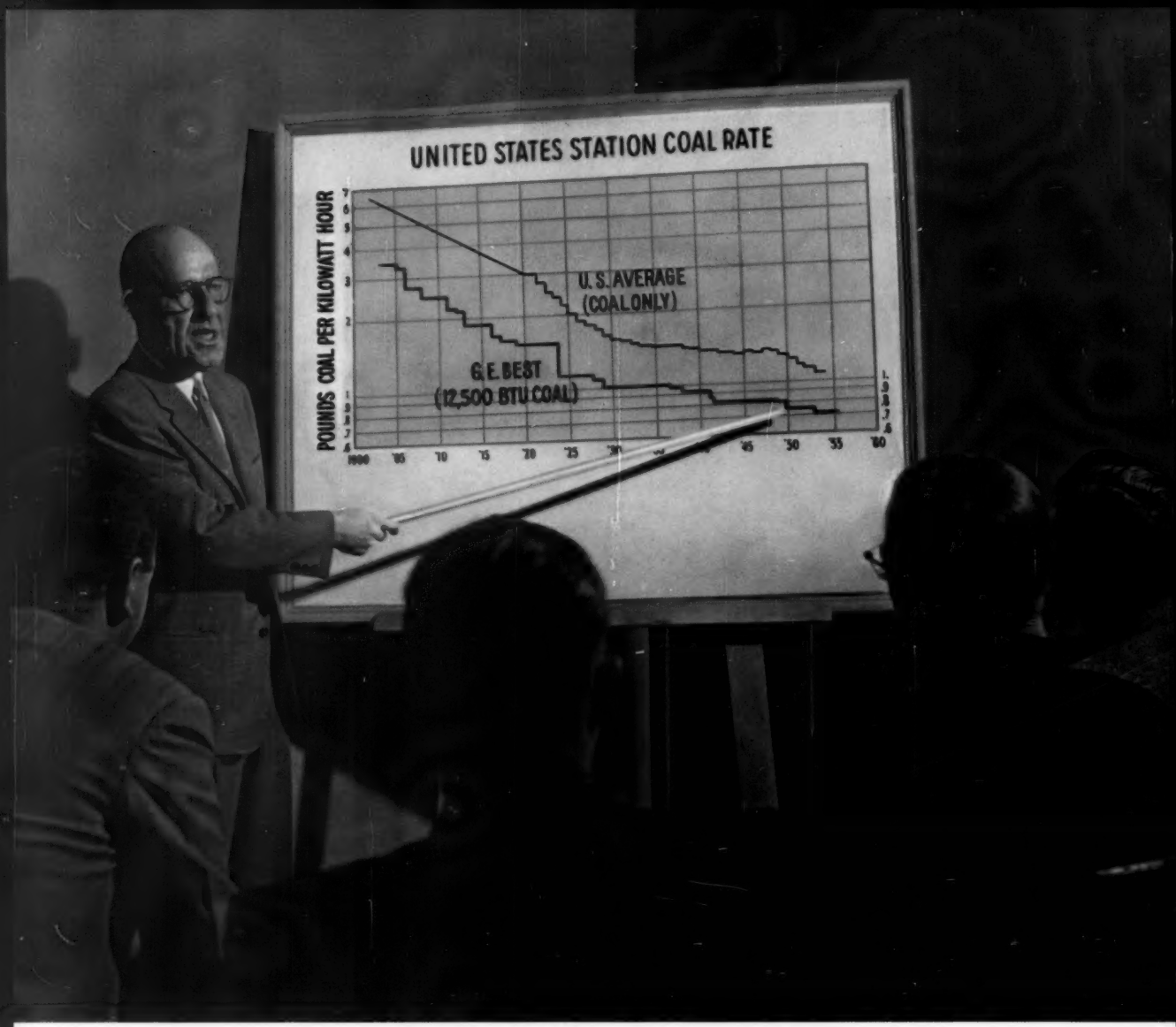
These are but a few of the ways in which General Electric's cross-compound design and arrangement have already achieved new highs in operating economy for turbine-generators. Read what C. W. Elston has to say about future turbine fuel economy on the next page.

Leader in Turbine-Generator Progress

GENERAL ELECTRIC



LOW-PRESSURE SECTION being assembled for careful factory inspection. This unit is one of the many large cross-compound turbines now being shipped to progressive electric utilities.



Can Turbine Fuel Economy Be Improved?

A statement by C. W. Elston, Manager—Turbine Engineering

The past twenty years have seen a phenomenal rise in the efficiency of steam turbine-generators. The best General Electric unit today requires 29 percent less fuel per kilowatt hour generated than the most efficient unit of twenty years ago. Can this improvement record be continued over the years to come?

It seems safe to answer that question in the affirmative. While future gains may not be quite so spectacular, there is considerable room for further improvement. The future increase in steam turbine-generator efficiency will come in part from the use of higher steam pressures and temperatures, and in part as a result of further development in the art of designing turbines.

The opportunity for continuing improvement in turbine efficiency presents a challenge that is being met by the ingenuity and creativity of many G-E people in research, engineering, and manufacturing. Large Steam Turbine-Generator Department, General Electric Company, Schenectady 5, New York.

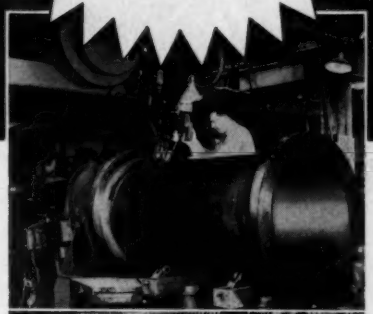
254-21

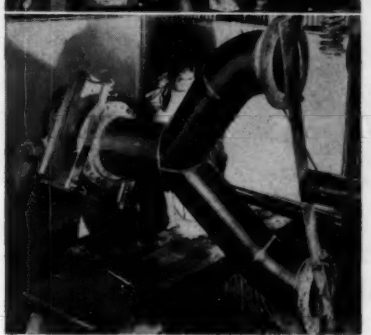
Progress Is Our Most Important Product

GENERAL ELECTRIC

WELDING at Pittsburgh Piping

another P. P. & E. service which contributes to *Improved* HIGH-TEMPERATURE HIGH-PRESSURE PIPING





Standard welding procedures at Pittsburgh Piping are: inert gas tungsten arc (above); automatic submerged arc (center); and manual metallic arc (bottom).

Modern power and process piping fabrication requires the highest degree of welding skill, as well as technical supervision which provides complete control of welding procedures. All Pittsburgh Piping welders and welding operators are performance qualified in accordance with Standard A.S.M.E. Welders' Qualification Test. They are specially trained in the exacting requirements of fabricating piping and related equipment for high-temperature, high-pressure central station service, corrosion-resistant applications, and nuclear power installations.

Fabricated high pressure boiler feed piping shop fabricated at Pittsburgh Piping. Comprises bends and forged laterals.

PRODUCTS AND SERVICES

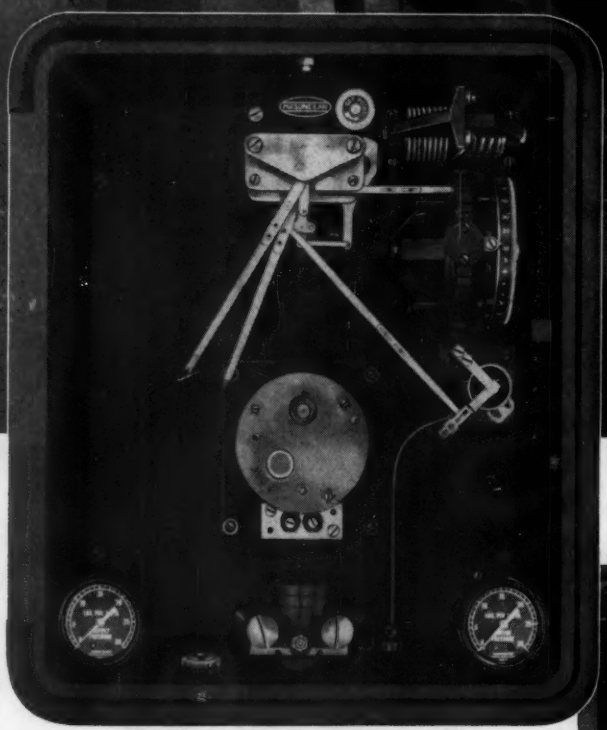
Carbon Steel Piping	Forged Piping Materials
Cast Iron Fittings	Headers
Cast Steel Fittings	Manifolds
Chrome-Moly Piping	Pipe Bends
Copper Piping	Stainless Steel Piping
Corrugated Piping	Van Stoning
Creased Bends	Welded Assemblies
Expansion Bends	Welded Stainless Steel Tubing
Flanges	Welding Fittings

PP-20

Pittsburgh Piping AND EQUIPMENT COMPANY
158 49th Street — Pittsburgh, Penna.
CANADA: CANADIAN PITTSBURGH PIPING, LTD.
835 BEACH ROAD—HAMILTON, ONTARIO

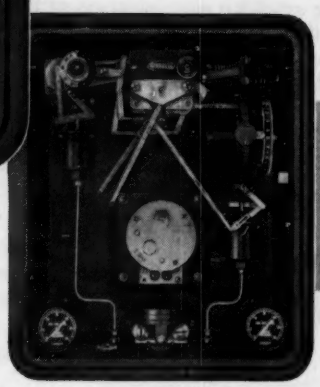
OFFICES IN PRINCIPAL CITIES

Atlanta	Whitehead Building
Boston	10 High Street
Chicago	Peoples Gas Building
Cleveland	Public Square Building
Hollywood	1828 North Alexandria Ave.
New Orleans	P. O. Box 74
New York	Woolworth Building
Syracuse	113 So. Salina Street
Toronto	68 Yonge Street

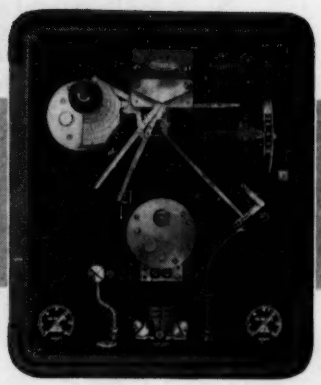


BASIC 60000
PNEUMATIC CONTROLLER

The basic controller provides versatility by combining proportional, differential-gap and on-off control, each with reversible action, in one instrument. Subassemblies may be installed to add the functions of reset and derivative. The exclusive gimbal unit enables you to select type of control and action and to adjust proportional band with one simple setting of the proportional band wheel. Large knurled knobs facilitate adjusting set point, reset rate and derivative time. All settings are made without disturbing the chart.



These are the functions you can perform. Pneumatic Set may be added to provide pneumatic positioning of the set point. Remote operation uses output pressure from another controller, a transmitter or a manually adjusted loading regulator.



Time Schedule may be added to position set point in accordance with a process-time schedule. Cam operation and chart record are in same instrument. Separate cam drive permits recording two or more cycles during one chart rotation.

THE VERSATILE 60000 ADVANCED LINE OF MASONEILAN CONTROLLERS

Complete series of pneumatic controllers features accuracy, dependability and simplicity — low over-all cost.

The answer to measuring or controlling your process can very likely be found in these Masoneilan Controllers. Many different functions can be performed, separately or in combination, using this advanced 60000 series. The features and flexibility are noteworthy:

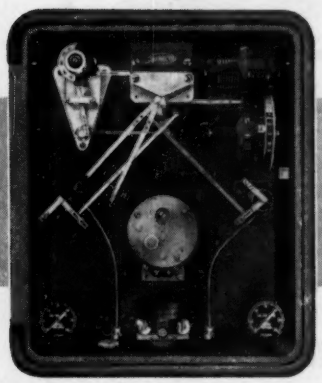
- Unit subassemblies for independent servicing or interchange.
- Gimbal unit provides four combinations of primary and feedback motion.
- All air passages manifolded — with plug in connections for all pneumatic units.
- Modern design, tailored appearance — easy to mount and to service; recording or indicating types.

Select the right combination for your process control from the variety of models shown here. Then, plan to standardize on this advanced line — it will save you money on over-all instrument investment and pay-off in dependable performance. Contact the Masoneilan representative nearest you, or write:
Mason-Neilan Regulator Co., 1207 Adams St., Boston 24, Mass.

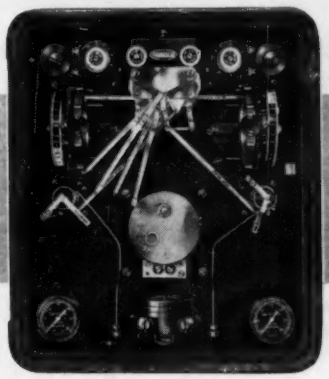
MASON-NEILAN MASONEILAN

Division of Worthington Corporation
33 NAHATAN STREET, NORWOOD, MASSACHUSETTS

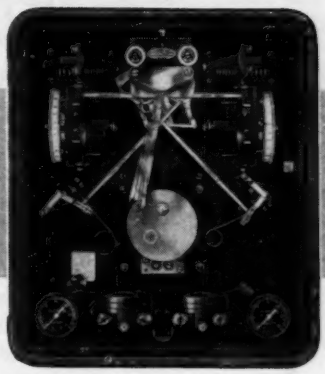
Sales Offices or Distributors in the Following Cities: New York • Syracuse • Chicago • St. Louis Tulsa • Philadelphia • Houston • Pittsburgh • Atlanta • Cleveland • Cincinnati Kansas City • Phoenix • Detroit • San Francisco • Louisville • Salt Lake City • El Paso Albuquerque • Charlotte • Los Angeles • Corpus Christi • Denver • Appleton • Birmingham New Orleans • Dallas • Seattle • Mason-Neilan Regulator Co., Ltd., Montreal and Toronto



Differential mechanism is added to position set point by one of two similar variables between which a differential is being maintained by controller; or by one of two dissimilar variables between which the controller is maintaining a relationship.



The Dual Selector Controller consists of two complete control mechanisms which actuate a common pilot interchangeably, according to process requirements. It is used where two related variables may be controlled by a single valve.



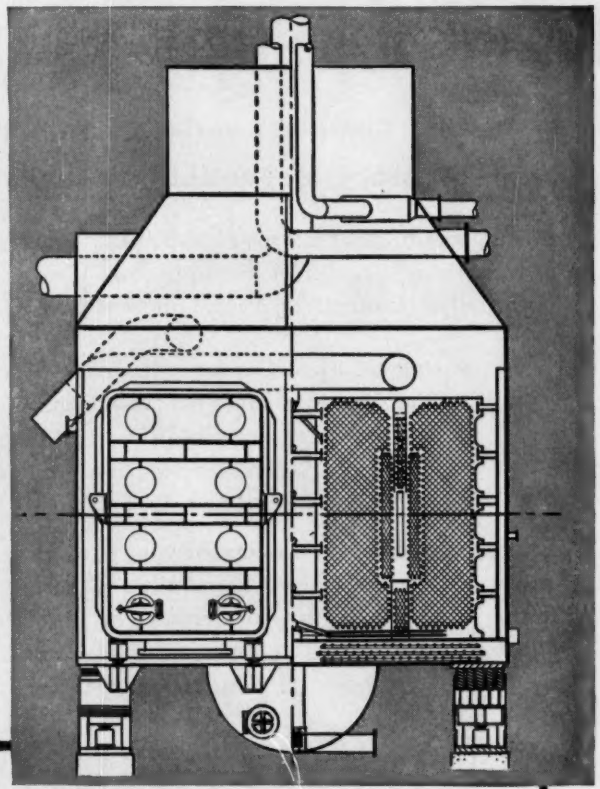
Dual Controller has two complete units, including primary elements, in one case. Controls two similar or dissimilar variables and either or both may be recording or indicating. Duplex Controller has two mechanisms but one primary element. May be two controllers or controller and transmitter.

Modern Dual Bank Condensers Pioneered by C. H. WHEELER

For 40 years C. H. Wheeler has led in steam power plant condenser design, from the first Dual Bank Condenser introduced to this country in 1916 to the most modern design for today's huge turbine-generators.

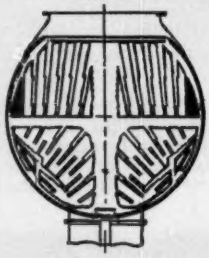
The latest C. H. Wheeler Dual Bank Condenser design for the largest metropolitan utility will provide 187,000 sq. ft. of surface to condense 1,600,000 pounds of steam per hour at 1.86 in. Hg. abs.

On the drawing boards now are new designs anticipating tomorrow's turbine requirements.

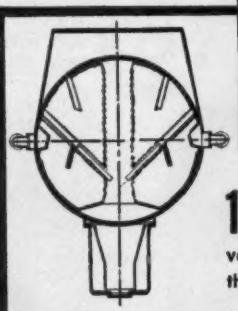


Modern Design Features..... 1956

1. **Specifically designed for today's larger, more efficient generating stations.**
2. **Adaptable to your station layout.**
3. **Lower pressure drop and higher vacuum. Additional steam lanes shorten path and resistance of steam travel.**
4. **"Zero" condensate temperature depression.**
5. **DEAERATION... 0.01 cc. per liter is attainable.**
6. **Airtight.**



1941 Additional steam lanes allowed steam to penetrate deeper. Further improvement in pressure drop. Better deaeration.



1923 Wider steam lane. Condensate temperatures corresponded to vacuum temperatures. Oxygen content less than 0.03 cc. per liter.

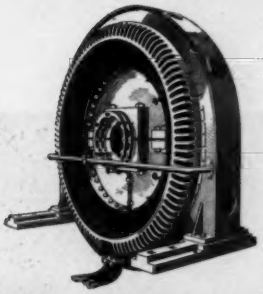
1916 An early C. H. Wheeler Dual Bank Condenser. Condensate temperatures approaching vacuum temperatures were achieved.

Let us tell you how our advanced designs will meet your operating requirements. Contact your local representative or

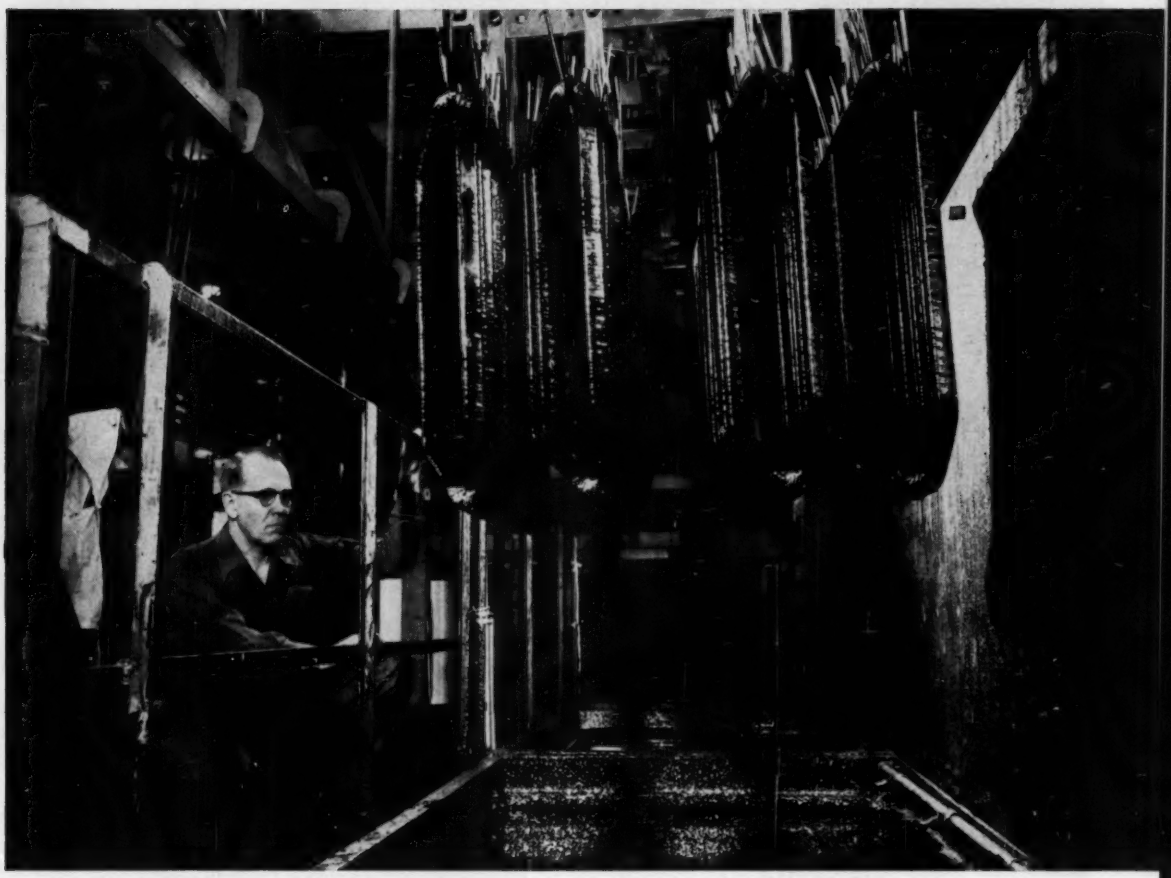
C. H. WHEELER MANUFACTURING CO., 19TH & LEHIGH, PHILADELPHIA 32, PA.

Manufacturers also of Vacuum Equipment • Marine Auxiliary Machinery • Centrifugal, Axial and Mixed Flow Pumps

C.H. Wheeler OF PHILADELPHIA



HOW G-E SYNCHRONOUS MOTORS
REDUCE MAINTENANCE COSTS



An insulating bath helps fight moisture

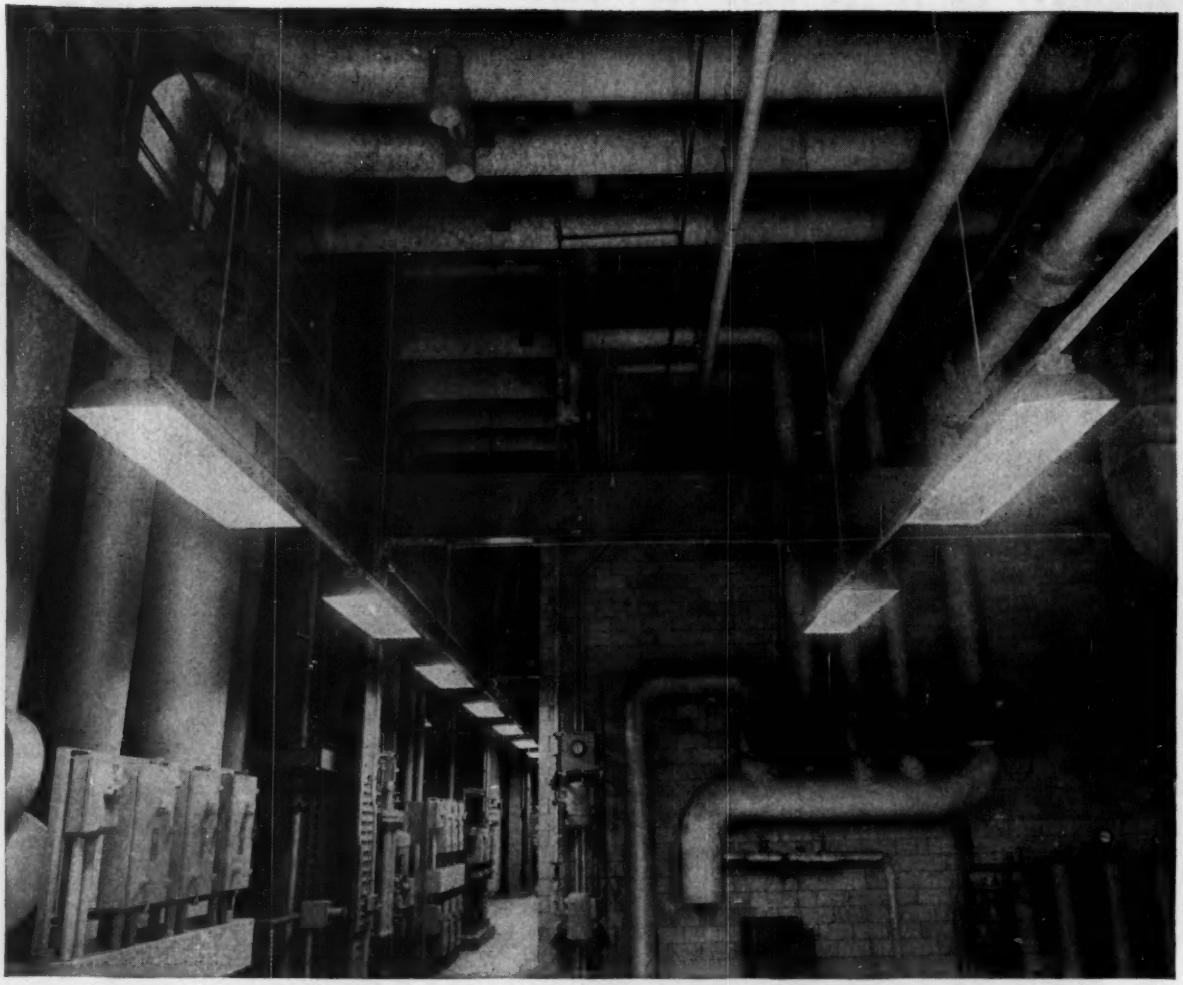
Moisture has the unhappy habit of working its way through motor coil insulation and reducing its capacity to withstand voltage stress. To guard against exasperating production-line shutdowns, General Electric seals coils with a coating of high-grade insulating resins. This seal is applied by a conveyor belt dip and bake system.

It works like this. After the main body of insulation is applied in the form of tapes and films of non-hygroscopic materials, each set of coils is placed on a conveyor and dipped in a bath of special, synthetic insulating materials. This way the coating is uniformly applied. Then the conveyor carries the coils into a huge oven and cures them for a specific length of time. The cycle is repeated until the proper seal is built up. Each step is automatically and precisely controlled—length of dipping and baking time and temperature.

This means the coils on your G-E synchronous motor are protected by a hard, tough insulation with high dielectric strength and high resistance to moisture and contaminants. Its glossy surface makes the coils easy to clean too.

All this adds up to less maintenance and down-time. For more information on G-E synchronous motors, contact your nearest General Electric Apparatus Sales Office or write Section 775-4 for Bulletin GEA-5332. General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC



NO HEAT LOSSES HERE! At TVA Widows Creek Power Plant, the vertical main steam line at left is insulated with 3" of K&M Hy-Temp and 2" of "Featherweight" 85% Magnesia. Distribution manifold and branch mains are insulated with 2" 85% Magnesia. Insulation contractor, Armstrong Cork Company.

K&M HIGH-PRESSURE INSULATIONS MEAN IMPORTANT HEAT SAVINGS

Piping heat-losses can be high if insulations are not designed for specific applications. K&M High-Pressure Insulations are so designed—to cut waste and save you money. There is a K&M High-Pressure Insulation for your every requirement.

For efficiency to 1900° F. there's K&M Hy-Temp Combination Insulation. It's made of diatomaceous silica, heat-resistant fillers and asbestos fiber, overlaid with K&M "Featherweight"® 85% Magnesia. Joints are staggered for the utmost in heating efficiency.

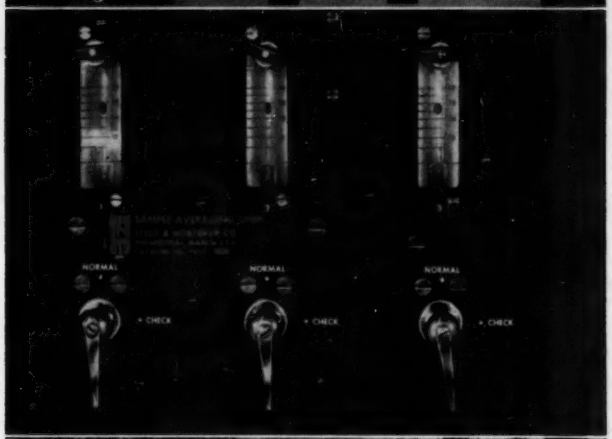
For efficiency to 600° F. there's K&M "Featherweight" 85% Magnesia. Made of 85% basic carbonate of magnesia and asbestos fiber, "Featherweight" withstands moisture, vibration and frequent temperature changes.

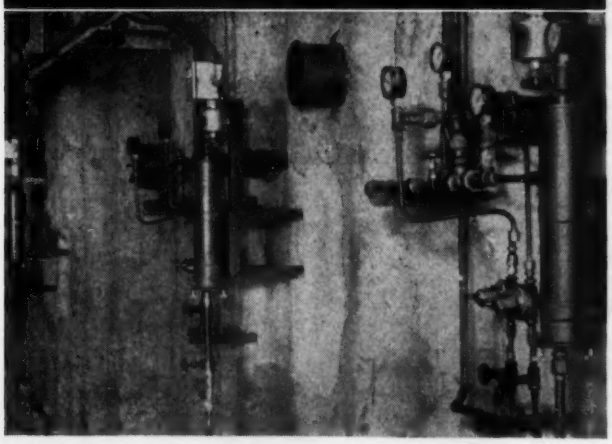
Contact your K&M distributor, who is an experienced applicator, or write directly to us, for further information.

KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

In Canada: Atlas Asbestos Company, Limited; Montreal, Toronto, Winnipeg, Edmonton, Vancouver

K&M Asbestos®





THE NEW SPEEDOMAX O_2 SYSTEM GIVES A CONTINUOUSLY ACCURATE COMBUSTION PICTURE...

Here's why!

■ Already, on some of the country's largest boilers, this new Speedomax O_2 System is enabling operators to trim excess air automatically to maintain combustion efficiency . . . and to do it with a certainty never before possible.

Why? As one operator put it, "The System gives me a record that's meaningful. When I look at this O_2 chart I know what's *really* happening—and I know it right away."

Behind this operator's confidence is the new L&N Multiple-Probe Sample Averaging Unit which *assures a more representative sample.* This unit maintains a true average from two, three, or more probes—even if individual sample flows drop 60 per cent. And excess air distribution across the duct can be checked right at the Averaging Unit.

There is also a new Reverse Jet Probe and Steam Sampler which delivers a *clean pressurized sample* even with the *dirtiest* of flue gases. Water jets flush the probe passage continually, steam ejector action pressurizes the sample, and steam condensing action plus centrifugal separation remove all dirt and acid.

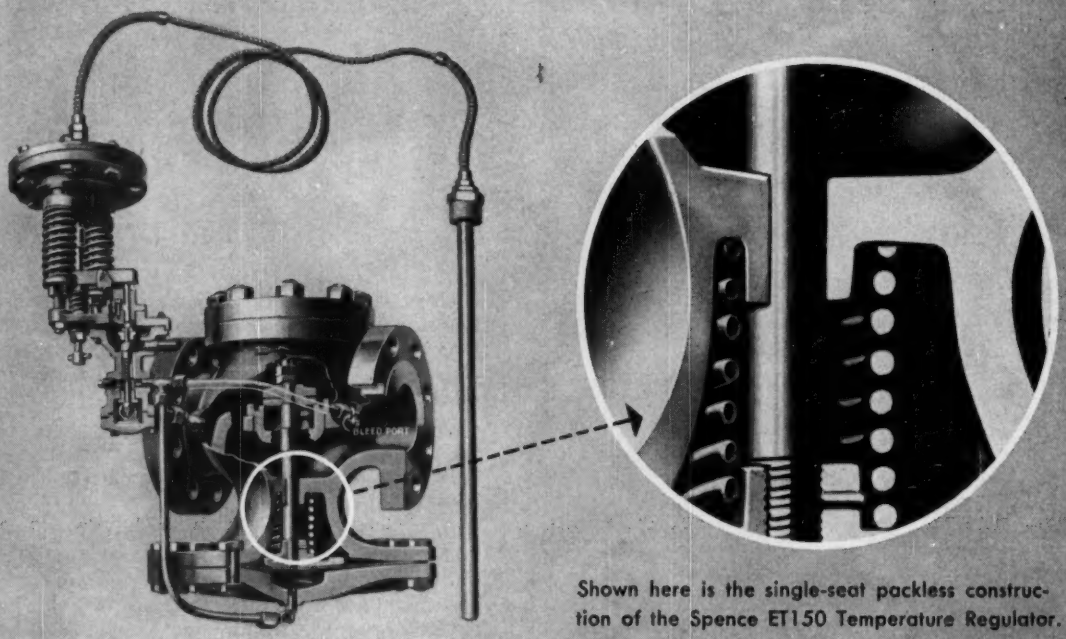
And, in analyzing and recording, the speed of response of the Speedomax Recorder, coupled with the efficient operation of the L&N Magnetic O_2 Analyzer, increases speed and accuracy of O_2 analysis and recording even further.

Why not learn more about this new Speedomax O_2 equipment and what it can do for you? Write to Leeds & Northrup Company, 4910 Stenton Ave., Philadelphia 44, Pa.

LEEDS NORTHRUP
instruments *automatic controls* • *furnaces*

VALVE TIPS:

Advantages of Packless Construction in Temperature Regulating Valves



Shown here is the single-seat packless construction of the Spence ET150 Temperature Regulator.

One of the biggest headaches in regulating valve maintenance is repacking stuffing boxes.

How often a valve needs repacking, how much time it takes, and the cost of the system downtime all vary with the construction of the regulator and the service it's used for. No matter how you calculate all these variables it's still a headache—and an expensive one.

In the temperature regulator shown above (Spence Type ET150) stuffing boxes are eliminated. This is done by what is known as "balanced" diaphragm construction. You can see in the cutaway drawing that pressure is applied to both sides of the large metal diaphragm. The upper side is exposed to delivery steam pressure and the lower side is exposed to loading pressure applied by the pilot. When the pilot closes, both delivery pressure and loading pressure are equalized through the bleedport and connecting tubing.

This construction not only does away with repacking problems, but it makes possible additional savings as well. For example, you will note in the sectional blow-up that this design eliminates a closely fitted stem and guide. Dirt or other foreign matter doesn't have much of a chance to lodge between these parts and cause sticking.

Another cause of binding or sticking, uneven expansion of closely fitted parts, is also eliminated with this design. In addition, valve stem wear is reduced for the same reason.

Lower maintenance is not the only advantage of this packless construction. Accuracy of regulation is also improved because friction due to a stuffing box, dirt, or uneven expansion is not a problem. The large, *balanced* metal diaphragm is more sensitive to slight changes in pressure.

Guaranteed Not To Wiredraw

If seats and discs are cut by steam (wiredrawn) the loss of steam through these grooves can be another expensive item — directly charged against the regulating valve. Fortunately, you can eliminate these costly leaks by specifying a temperature regulator that is *guaranteed not to wiredraw.*

Spence makes such a guarantee because their seats and discs are made of SECO Metal. Over 20 years experience with this special alloy has failed to produce a single case where a SECO Metal seat or disc had been cut by steam. All that's required is an approved strainer located ahead of the regulating valve. Expensive steam leaks just can't happen with this combination of SECO Metal and single-seat design.

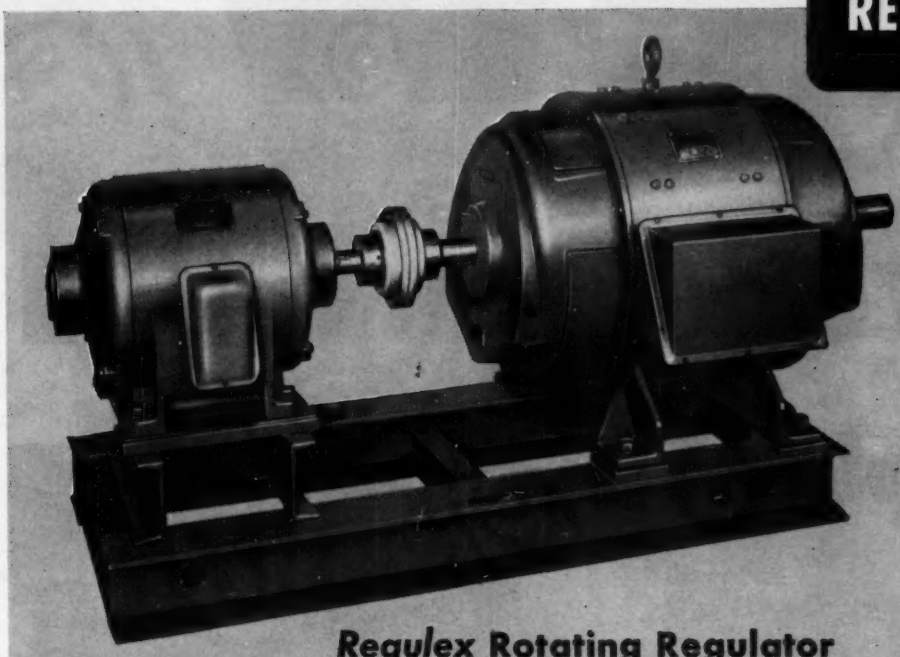
If you would like to have more information on Spence Temperature Regulators, drop us a line and ask for Bulletin T150. It gives more detailed information on these and other Spence design features. Piping layouts and helpful information on the installation of temperature regulators are also included. Write for your copy today.

SPENCE ENGINEERING COMPANY, INC.
Walden, New York

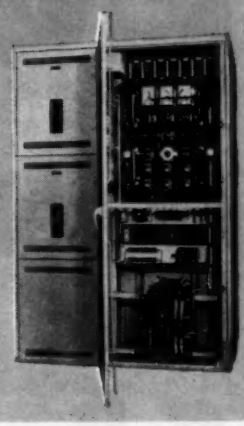
SE 140

A Type and Size for Your Specific Needs

ALLIS-CHALMERS REGULATORS



Regulex Rotating Regulator



Regulex regulator consists of m-g set and cubicle containing static elements. Cubicle may be combined with switchgear.

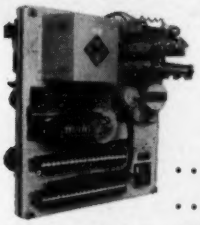
- Stability during high power-factor operations.
- Increased operating limits through automatic minimum excitation.
- High sensitivity and rapid response.

How It Works . . .

Automatic minimum excitation permits generator operation close to stability limit — much closer than manual operation. Sensitivity and quick response of *Regulex* regulator establish and maintain safe ratio between generator load and field current.

Where It Is Used . . .

In power plant application for voltage regulation of large generators or synchronous condensers. In industrial applications for regulating current, voltage, speed, tension, and reversing of processing mill equipment, and for arc-furnace control.



Magnetic AMPLIFIERS

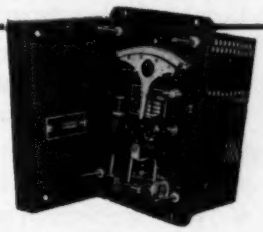
. . . Low maintenance

. . . High sensitivity

Designed for applications requiring high sensitivity and response, where regulator is subjected to shock, or where continuous performance is a prime factor. Used in conjunction with *Regulex* unit when reversed polarity output is required. Since the magnetic amplifier has no moving parts it requires little maintenance.

For complete information call your Allis-Chalmers representative, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

Electromechanical *Rocking Contact* Type Regulators



For voltage regulation of smaller ac and dc generators.

- Varies resistance in exciter shunt field by rocking action.
- Quick regulation over entire range with short movement.
- No sluggish relays.
- No vibrating or sliding contacts to wear.

Regulex and Rocking Contact are Allis-Chalmers trademarks.

ALLIS-CHALMERS

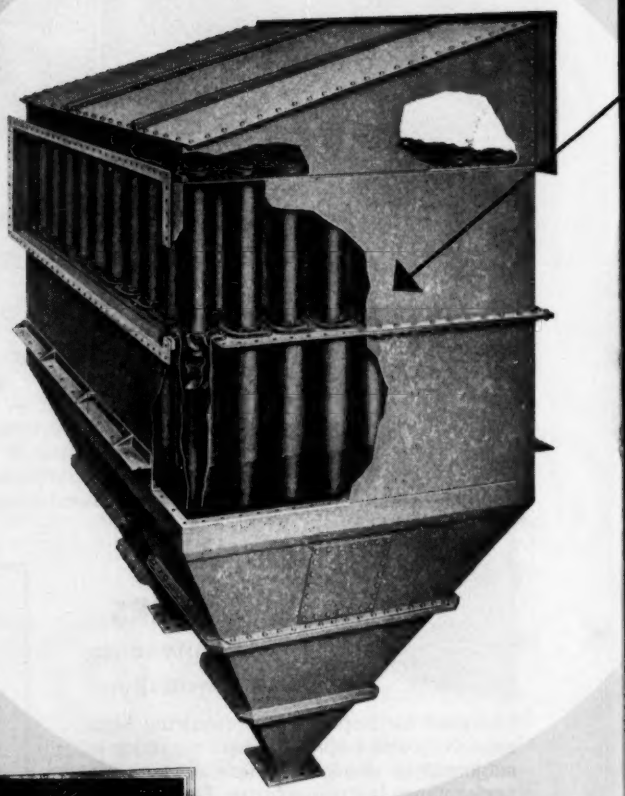
A-C ALLIS-CHALMERS

A-3873

NEW

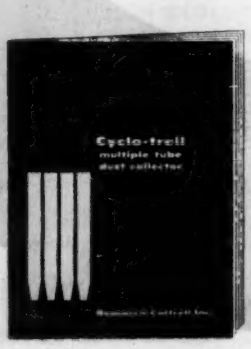
Cyclo-trell

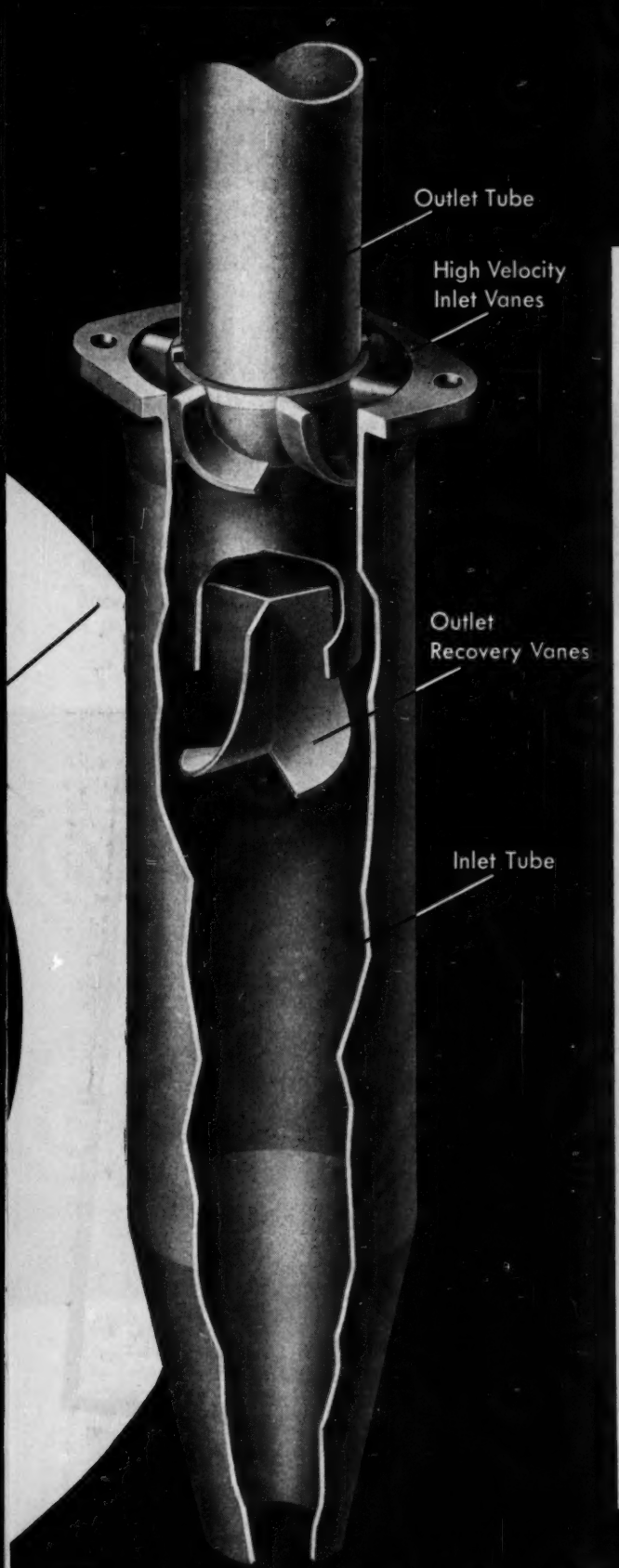
Multiple Tube Dust Collector



Here are a few brief facts on Research's new multiple tube mechanical collector.

- Collection efficiencies are higher, for a given pressure drop, than other conventional multiple tube collectors.
- Gas flow per tube is higher than conventional units. This means fewer tubes per collector and lower total cost for a given capacity.
- Cyclo-trell's design is based on Research's 45 years experience in manufacturing gas cleaning equipment. As the largest manufacturer of electrical precipitators in the world, Research-Cottrell has engineered and built many combination units consisting of precipitators and mechanical collectors.
- Bulletin M gives complete details on design features, efficiency, capacity and detailed dimensional drawings. Write for your copy today.





Higher Collection Efficiency

An important reason for Cyclo-trell's higher collection efficiency is the aerodynamically shaped inlet vane unit. The purpose of these vanes is to produce a fast spiral of incoming gas. The faster these gases spin, the greater the centrifugal force on the suspended dust.

After testing many types and curvatures of vanes, Research found that this new design resulted in less turbulence, greater centrifugal force and higher collection efficiencies.

Greater Gas Handling Capacity

To develop a higher gas flow capacity than other multiple tube collectors, Research's engineers developed the following design features. First, by using a 10" diameter inlet tube, instead of the conventional 9" tube, the flow of incoming gas was increased.

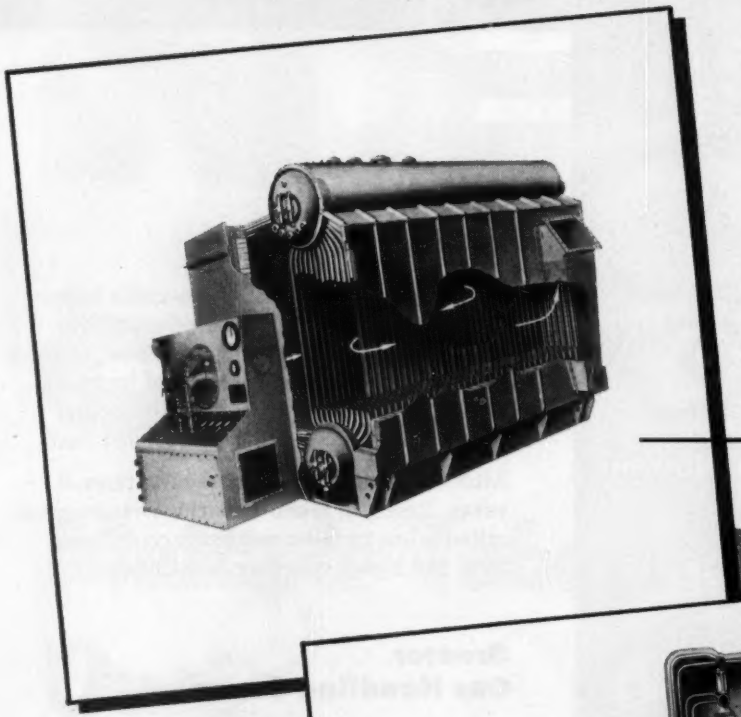
The next step was to straighten the gas flow as it entered the outlet tube, since a spiraling gas stream creates more resistance than a straight through flow. In the Cyclo-trell this spiral is eliminated, and energy is recovered in the outlet tube by the Outlet Recovery Vanes. By positioning these vanes below the tube, rather than inside the tube, resistance has been further reduced.

This combination of features means greater gas flow per tube, fewer tubes per collector and a lower total cost for a given capacity and efficiency.

Research-Cottrell, Inc.

Main Office and Plant: Bound Brook, New Jersey • 405 Lexington Ave., New York 17, N. Y.
Grant Building, Pittsburgh 19, Penna., 228 No. La Salle St., Chicago 1, Ill. • 111 Sutter Bldg., San Francisco 4, Cal.

MODERN OIL AND

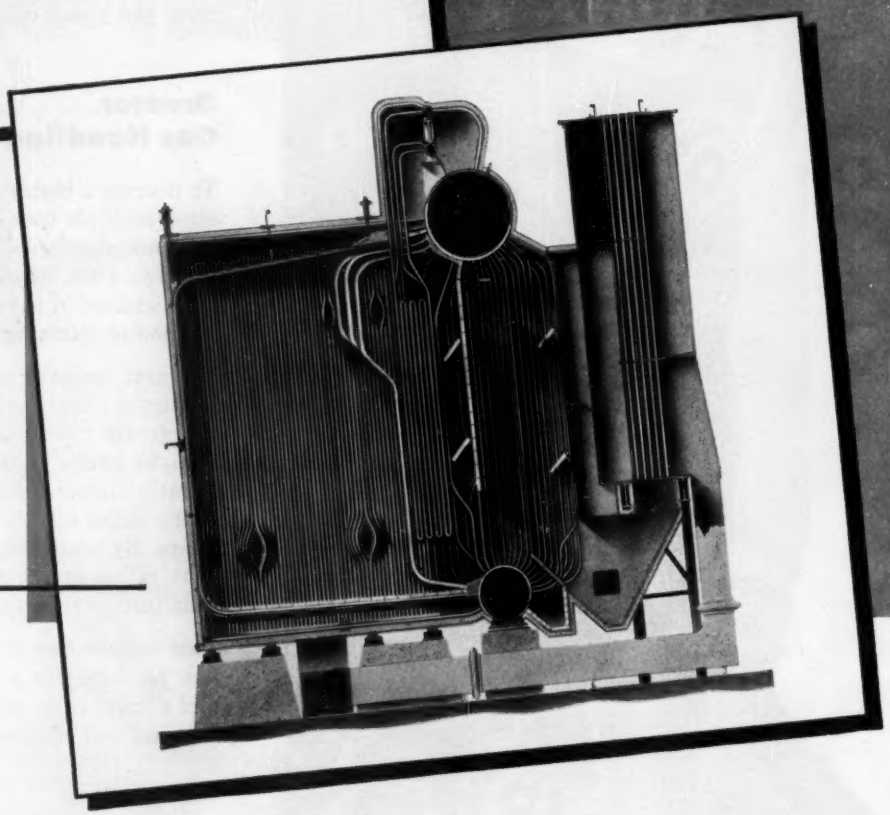


C-E Package Boiler—Type VP

Completely shop assembled . . . available in fourteen sizes from 4,000 to 40,000 lb capacity . . . pressures to 500 psi. Available with integral console control panel, this unit contains more water-cooled area per cubic foot of furnace volume than any other boiler of its size and type. It can be equipped with any of several approved burners.

C-E Vertical Unit Boiler —Type VU-55

Available in six sizes . . . capacities from 50,000 to 120,000 lb steam per hour . . . designed for two pressure ranges, 250 psi and 500 psi, and total steam temperatures up to 750 F. This double cased, gas-tight unit is equipped with tangential burners. A large (60-inch) steam drum assures generous water capacity and steam reservoir space. Tangent tube waterwalls offer complete furnace protection, minimizing maintenance.



COMBUSTION

Combustion Engineering Building

STEAM GENERATING UNITS • NUCLEAR REACTORS • PAPER MILL EQUIPMENT • PULVERIZERS • FLASH DRYING

GAS FIRED BOILERS

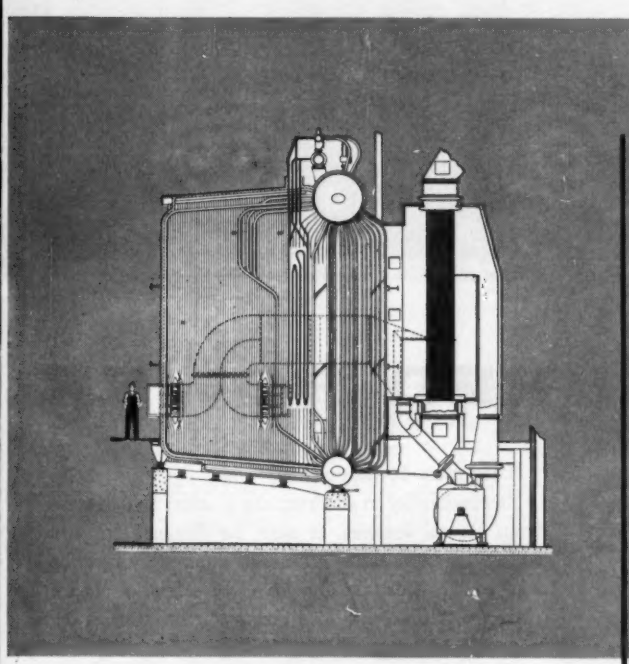
The boilers illustrated here cover the broad capacity range from 4,000 to 600,000 lb of steam per hr. They are all especially designed for gas and/or oil firing. The two units shown on the left page (Types VP and VU-55) are standardized and each is available in several sizes. The capacity range covered by these two units is from 4,000 to 120,000 lb per hr. The two units below are custom designed for various capacity, pressure and temperature requirements up to 600,000 lb per hr, 1400 psi and 950 F. All these units are pressure fired and do not require induced draft fans.

Collectively, they offer an exceptional diversity of choice. A brief consideration of the features of each type will help you "pinpoint" the design characteristics best suited to your particular needs.

Of course there are other C-E two drum Vertical-Unit Boilers available for pressures up to 1400 psi and temperatures up to 960 F. Shown here are but four popular members of the C-E family of Vertical-Unit Boilers—a family which has achieved a wide measure of acceptance using all types of fuel.

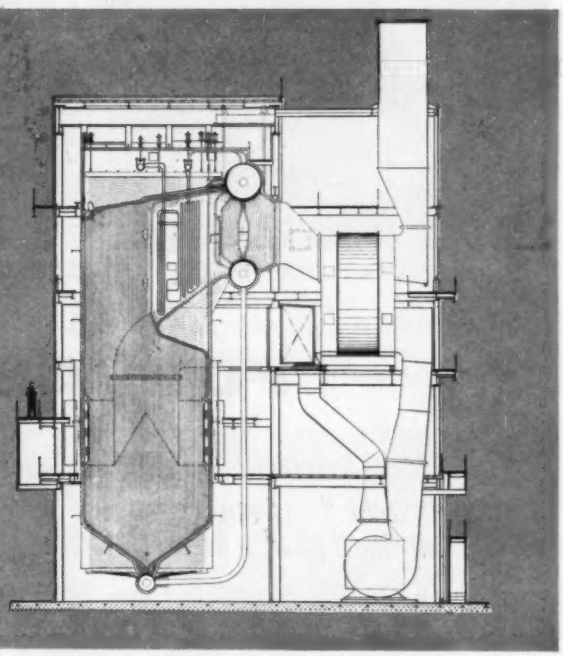
Please feel free to call on us for further detailed information. Catalogs are available upon request.

B-922



C-E Vertical Unit Boiler—Type VU-50B

This unit is available for capacities from 50,000 to 400,000 lb per hr—pressures to 1400 psi and temperatures to 950 F. This bottom-supported design uses tilting tangential burners providing effective superheat control. Horizontal burners can be furnished if desired. Heat recovery equipment as required. This unit makes available to industrial installations a standard of performance comparable to utility practice.



C-E Vertical Unit Boiler—Type V2

This unit is available for capacities from 200,000 to 600,000 lb per hr. It can be designed for pressures up to 1400 psi and for temperatures to 950 F. Tilting tangential burners, providing superheat control, are standard equipment although horizontal burners are available, if desired. A double, gas-tight casing assures lifetime tightness and minimum heat loss. Heat recovery equipment can be furnished as desired.

ENGINEERING

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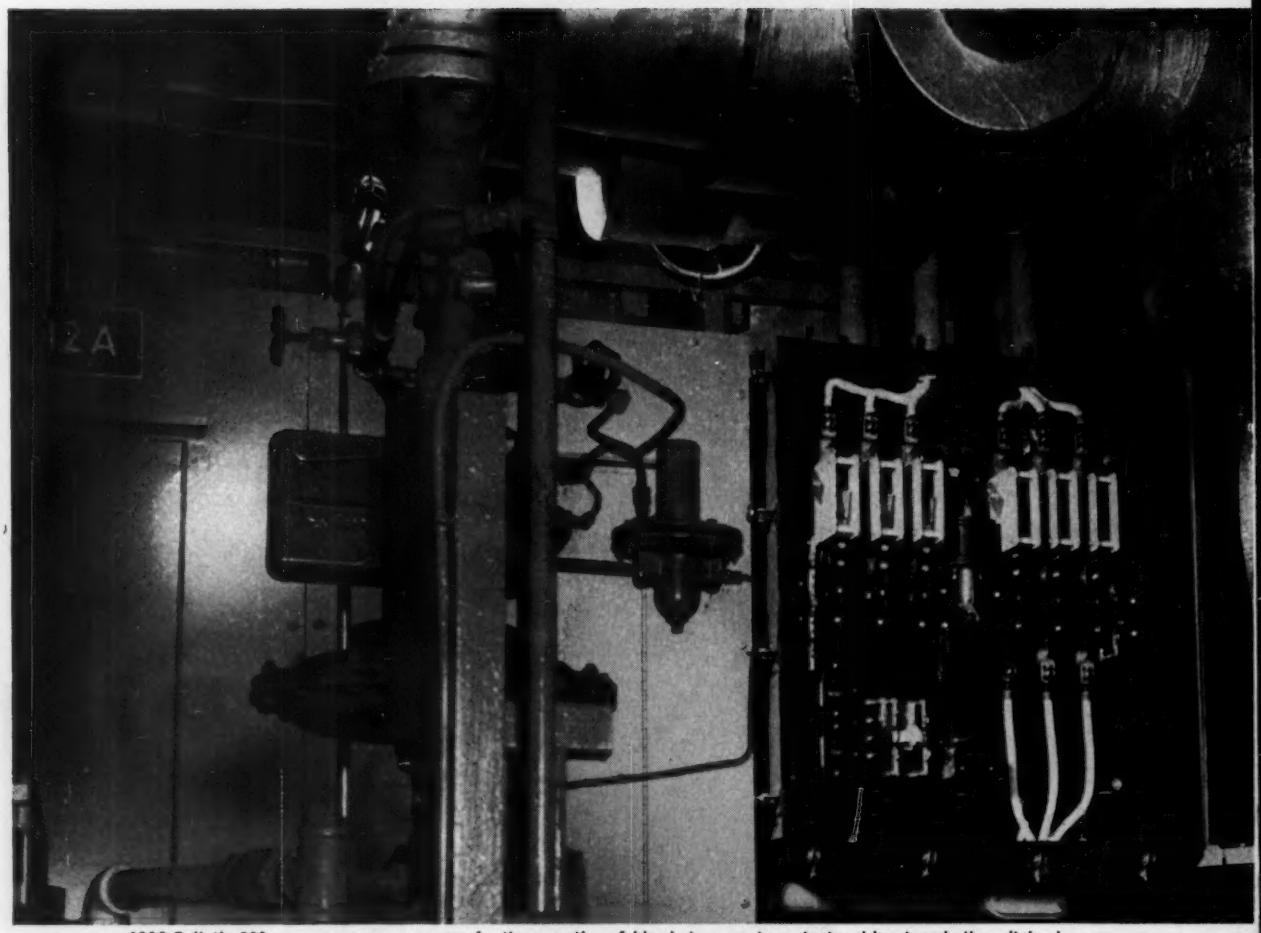

ASCO Bulletin 906 assures emergency power for the operation of bleed steam, water output and input, and other vital valves.

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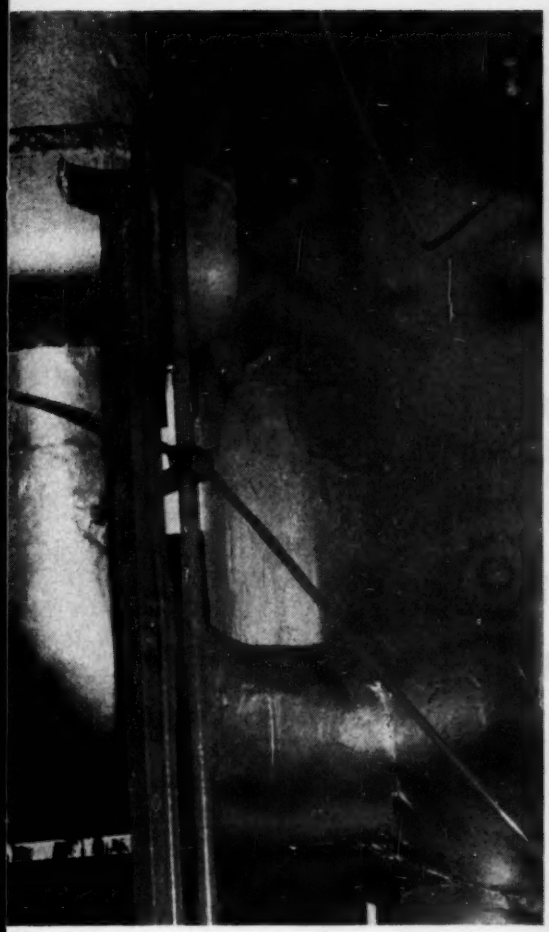

CONTINUITY

tacts . . . *single coil design,* providing construction simplicity, quiet operation . . . *built in time delay* so the equipment ignores harmless momentary outages.

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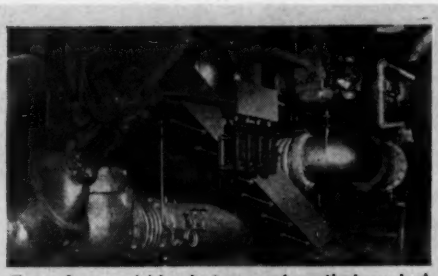
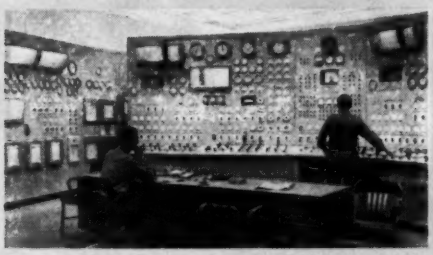
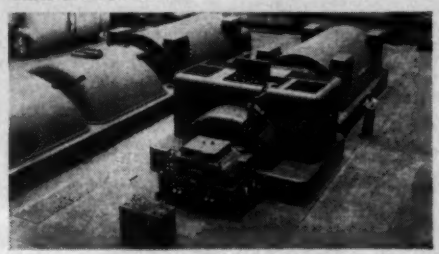


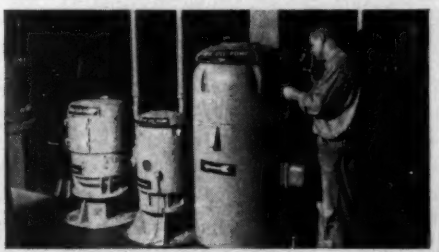
Two of several bleed steam valves that control the flow of steam from turbines to the main condensers.



Power source for the operation of instruments on the control panel must not fail. Several ASCO units are used here.



Continuous lubrication of the main shafts in the turbo-generators is assured by auxiliary pumps shown in the photo below. The power for this equipment is assured by an ASCO Automatic Transfer Switch.



Inspector checks the oil level in the auxiliary lubricant pump for the generators.

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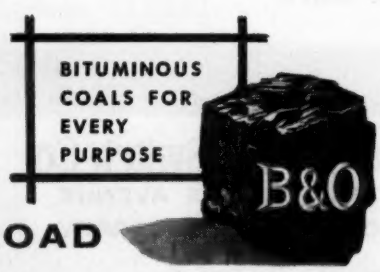

BALTIMORE & OHIO RAILROAD

LOUIS N ROWLEY, EDITOR • SEPTEMBER 1956 • ESTABLISHED 1882 **Power**

Story behind the PTG story

THIS ISSUE launches an editorial program designed to show American industry how to insure *power to grow . . . electrically.* I think you'll be interested to know how it all started and why we consider it of major significance.

The story behind the story began when electrical manufacturers and utilities were preparing a concerted drive to make the public aware of the true cost of inadequate wiring in the home. Now we see all around us the slogans "More Housepower" and "Live Better Electrically." Magazine ads, car cards, outdoor signs, radio-TV commercials all tell us we need to beef up the wiring in our homes if we want to enjoy the benefits of major appliances.

There's a parallel problem in industry, as Managing Editor Jim O'Connor pointed out more than a year ago, when we were discussing the beginnings of the residential "Housepower" campaign. Many of today's manufacturing plants find production hindered by inadequate electrical facilities. More important, many in-plant electrical systems now being built or modernized will soon feel the pinch because short-sighted planning has left them without the capacity and flexibility that are necessary if future loads are to be met economically.

If we ever had any doubts about these conclusions, they were dispelled when we started a series of field checks and meetings with leading industrial engineers, consultants and manufacturers. There *is* a problem: right now, in the midst of a national economy bursting with growth, a majority of in-plant electrical systems lack what it takes to keep pace with that growth.

This is a matter of prime concern to all industry, and particularly to the power-service engineers of industry. On you rests the responsibility for making your management aware of the imperative economic necessity of power to grow, and, with management backing, insuring that the in-plant electrical system in your charge *will* have the power to grow.

By the same token, POWER has a responsibility —to be your right hand in this effort. Hence the editorial program that begins on p 75. This year-long series of major articles starts by demonstrating the critical need for power to grow. And does it in terms designed to make your management urgently aware of that need.

At every stage, the program will pose the two alternatives: the short-sighted way of waiting until load growth forces expensive rebuilding vs the far-sighted way of planning into the electrical system the ability to expand economically. And it will show how to build power to grow into each part of the system, from the primary substation to the point of application at the load.

In planning this program, we have sought the cooperation of all factors in the electrical industry. We hope our program will be paralleled by campaigns sponsored by manufacturers, by utilities, and by industrial groups. In the favorable climate created by this concerted effort, we count on power-service engineers everywhere to work with their managements to give American industry the power to grow that is so essential if we are to meet the challenge of the dynamic years ahead.

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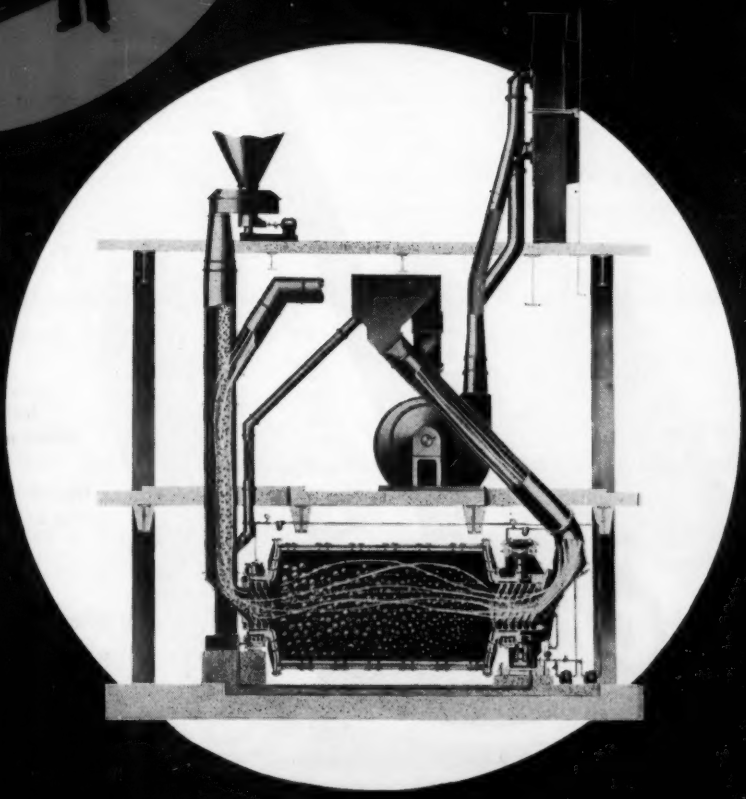

COAL FIRING SYSTEM

Cutaway drawing of Kennedy Pulverized Coal Firing System showing disc feeder, pulverizer, classifier, exhauster, burner. Raw coal is delivered to disc feeder and fed into tube mill.

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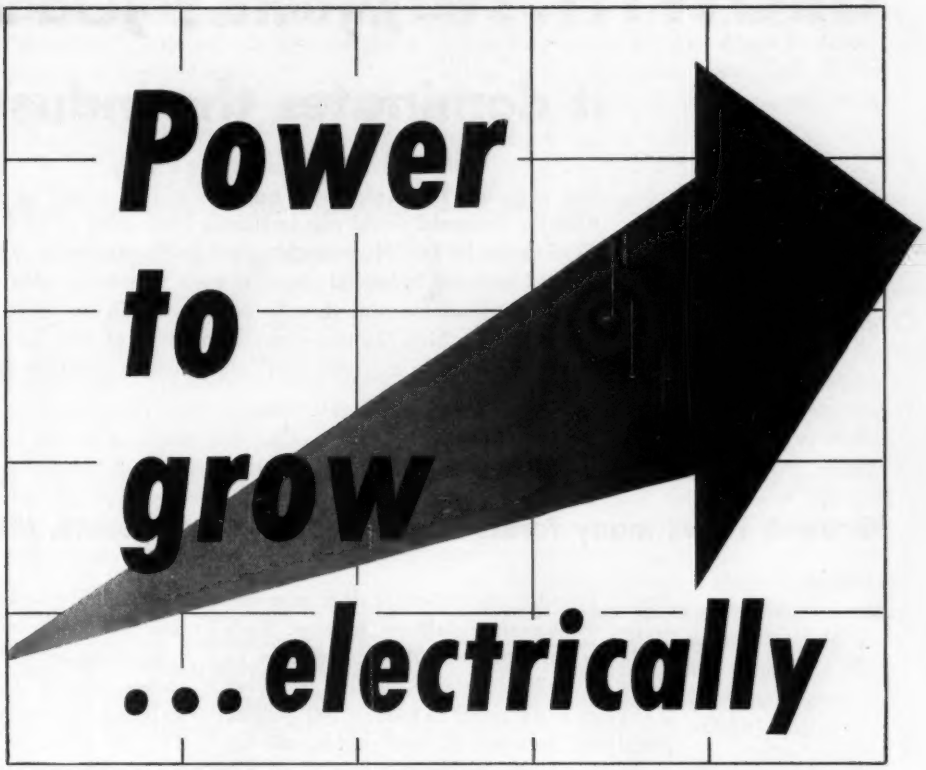


- **Growth is today's biggest industrial fact. Gearing up for it rates No. 1 priority for power-service men, top management**

- **If your in-plant electrical system is typical, it's pushed right now, hasn't got what it takes to meet future demands**

- **That means a 2-part job for you: (1) planning power to grow into the electrical system on which production depends, and (2) convincing top management that a small investment now for expansion flexibility will pay off in the years ahead**

- **To help you plan PTG into every part of your electrical system, and to sell it topside, we launch here a major editorial program. First article: Why PTG is a must—now!** ——▶

continued

GROWTH: Everywhere you look it dominates the industrial scene

Few engineers or management men are willing to try to describe exactly what the industrial world will be like in 1960, 1965 or 1970. But one thing all of us can be sure of—everything will be bigger.

Right now our industrial output is more than twice what it was in 1940. And it promises to come close to doubling again by 1970. There just has never been anything like this economic machine of ours for sheer size, sheer power, sheer ability to produce millions of tons of products each year.

Growth takes many forms: more people, more plants, more production

Sturdy base for growth of the U.S. economy is the continuing population upsurge. Each 24 hours the U.S. gains 7200 citizens. In 15 years this will lift total population well over 200 million, compared to today's 168 million. Satisfying the wants of more people calls for more plants and equipment.

This year and next, for example, American industry will dig into its pockets to the tune of $39 billion for expansion. Reporting these figures in the Ninth Annual McGraw-Hill Survey of Business Plans for New Plants and Equipment, executives expressed doubt only about ability to get and install the materials and equipment needed.

Looking beyond this year and next, forecasters predict an increase of about 45% in industrial production by 1965, and of about 75% by 1970. By 1970, the number of people working will grow, but hours worked each week will decline to an average of about 35. So total man-hours worked will rise only slightly. Big boost for the economy will come from continued gains in output per man-hour, a direct result of more machines and more power behind those machines.

Growth thrives on the stimulus of new products and new technology

Look at another facet of the growth picture: the great and seemingly unlimited market for consumer appliances. Think of the growth that occurs, direct and indirect, when a big new consumer product is put on the market. *Example:* 6000 television sets were produced in 1946; over 7 million a short seven years later. In those seven years, 65% of all American families became owners of TV sets. Take air conditioning as another example: More and more people are coming to believe that there's no more reason to be hot in summer than to be cold in winter.

How do we keep up with the spiral of more people wanting more things? The answer lies in ever-increasing productivity—ever greater output per man-hour. Put another way, industry continues to devise new ways

of producing a maximum of goods with a minimum of people. In popular terminology, the word "automation" describes a major factor in this trend.

No revolution begins at a precise moment of history. What does occur is a sudden awareness of a set of historical facts. So it is with automation. You might, for example, consider a loom developed in 1804 as the first "automated" machine. It followed instructions on a punched card.

Actually, in the past 25 years, just about every industry has felt some impact of this "new" technology. It may have been more automated forms of materials handling, more automatic feeding, loading, production and inspection. An example of essentially automatic production is found in the modern oil refinery. With a full complement of controls and instruments, such a refinery with 12 men can do the same job as one with 800 men but lacking automatic control and instrumentation. It is from developments such as this that ever higher output per man-hour stems.

Growth's lifeblood is electricity flowing through the arteries of industrial-plant distribution systems

It is probably fair to say that without electricity these advances in production could not be accomplished. Electricity is an incomparably convenient and versatile form of energy, as well as a part and parcel of most control systems that make automatic production possible. Small wonder then that today's industrial plants demand ever more kwhr and ever larger and more complex distribution systems.

The electrical system has come to be the cornerstone of modern production for a host of reasons. Motor drives have made it possible to boost the power of production machines for higher speeds and greater outputs. Without the convenience of motor drives, automated handling would be virtually impossible. Electricity is the basis for higher lighting levels needed for better seeing, and for the controlled climate needed for many processes. And to a greater extent, in the future, industry will air condition for the production gains resulting from increased worker comfort.

All these mean bigger industrial electrical systems. They also mean more complex and extensive systems. And as industry feels the continued impact of growth forces, its electrical systems must keep pace, must grow in capacity, flexibility and extent.

Growth's challenge: To meet it economically, our in-plant electrical systems must have *power to grow*

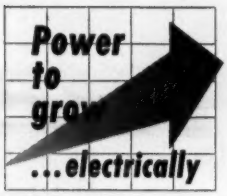
It is clear that increased productivity requires more kwhr per worker. Actually, the rate of increase in electrical usage will exceed the rate of increase in manufacturing output. *Example:* In 1956, some 21,150 kwhr were used per production worker. This is only the beginning. One dependable source sees kwhr per worker soaring to 36,000 by 1966, a 70% increase. Stacking this against an industrial increase of some 45% in the same period gives true significance to the importance of industrial electrical systems in the growth years ahead.

This is clearly recognized by the electrical manufacturers surveyed by POWER. One maker of distribution gear figures the total market for in-plant electrical equipment will grow 50% by 1966. Based on 1955 dollars, this is a $560 million market, compared to $375 million next year.

Utility companies, too, are preparing for the upsurge in industrial demand. Construction of new central stations, transmission lines and distribution facilities aims at doubling capacity in the next ten years or less.

The electrical equipment will be available, and so will the kwhr. That puts the challenge squarely up to industrial power-service men and their managements. If your in-plant electrical system is to keep pace with growing production, and do it at lowest cost, you need to start planning now for *power to grow . . . electrically*.

Turn page for details on how PTG pays off—▶



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THE PTG PAYOFF: You must plan now

The one electrical shortcoming shared by too many industrial plants, commercial buildings, hotels and institutions is undersizing: undersized feeders, transformers, switchgear. Original layouts, adequate for their day, become outmoded as new loads creep in slowly.

Load growth generally comes in small chunks: new motor here, new process there, better lighting throughout. As this growth occurs, the local utility usually keeps pace by beefing up its lines, thus upping available short circuit current. Load increases steadily, and one day you find yourself with an inadequate electrical distribution system.

As time rolls by you get used to living with a third-rate electrical system—and the hazards build up. What hazards? Inadequate circuit breakers are probably the biggest. If they're called on to open under a full short circuit, chances are they will blow apart. We've seen it happen.

The short-sighted view taken by many plants can be summed up this way: "If the motors run and the circuit breakers hold in, why fuss?" Business men are, by nature, keenly appreciative of a dollar saved, so, many of them take a hold-the-fort attitude toward additional electrical expense simply because

You *could* sit back until growth forces your hand. Revamping then may

Do you really save money by holding electrical design plans close to the load line? Sure, you'll save money at the start—on equipment, space, and labor. You can buy smaller breakers, transformers, cables. And if there's no load growth, chances are you might get away with it.

But let the load curve start climbing, as it's bound to do. Then you're in trouble. Then you must face up to the real shortcomings of a system with no power to grow—a system with a PTG index of 1 (*far right*). What will it really cost to revamp such a system?

We put this question to leading industrial and consulting engineers at our recent PTG Conference (photo, p 81). Most agreed that revamping a system planned without regard for future expansion costs 3 times what a carefully thought-out initial installation would have cost.

Why 3 times? Chances are some equipment originally installed would have to be scrapped or sold. Then too, you're faced with the all-important problem of getting

But look-ahead planning, plus a small additional investment today,

Is a PTG system expensive? No, but it will cost more initially than a "minimum" layout. Payoff for the few extra dollars you invest today comes later.

Actually the main ingredient in a PTG system is far-sighted planning. You and your top management must have the vision to spend time now to gain future dividends.

This means looking ahead with your top management to gage the effects of future new products and production changes. The more info of this kind you have, the better your prospects for sizing up future loads. Do you provide capacity now for such loads? Hardly.

The smart approach—the PTG way—uses data on future demands to permit *planning* a complete system to meet them. You then install only what is needed for present loads, but you have automatically provided the space for later expansion. And you've chosen pres-

to insure it

they don't know the full score. And we find, all too often, that little or no attempt is being made by plant-service engineers to sell top management on the urgency of looking ahead electrically.

Here's an angle, often overlooked: If you keep close check on your electrical maintenance costs, you'll find an inadequate system a real dollar waster. Figure how many dollars are lost in downtime alone when production men complain that motors are grunting under load and starters won't hold in. And when the electrical setup interferes with the production quota, you'll hear about it.

well cost 3 times as much

space for additional gear. This is often the biggest headache, especially if you have to take over production space in a "high real estate" section of the plant.

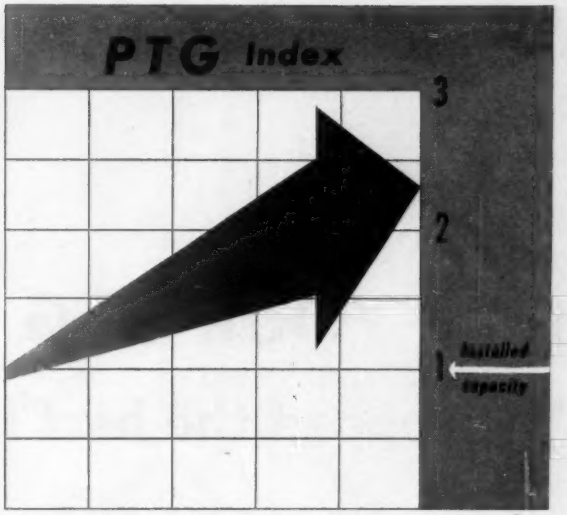
And, even after you have the equipment and space problems licked, you still have to find a way to install the addition without interfering with plant production.

On the other hand, if you have PTG, new equipment blends in with old, space has been provided for, and changes can be made quickly, without excessive downtime.

is the economical answer

ent equipment that will fit into the expanded distribution system. This latter factor will prove a real money saver in the years ahead.

The forecasts you and your management make today about tomorrow won't be exact—they can't be. But by allowing for tomorrow in today's planning you can't help but make the actual later expansion job easier and cheaper. And that's just what we'll be talking about in future articles of the PTG program.



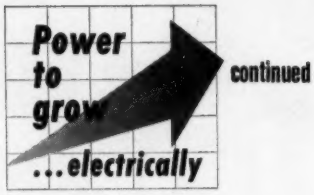
The PTG index and how to use it

You may well look upon the load capability of an industrial electrical distribution system as being divided into two parts. First, the broad base that can handle present load plus any firm future loads; we call this segment the installed capacity. Beyond this is the power-to-grow area. We define the PTG area as the planned-for-capacity that can be economically provided and integrated into an existing system. Planned power-to-grow capacity divided by installed-capacity is what we call the *PTG index.*

By tagging the installed-capacity as unity, the PTG index gives some measure of a system's expansibility. Since PTG concerns itself with providing for growth the major ingredient is planning. The specific PTG index value illustrated above was selected simply to illustrate a point. Value best suited for your plant is something for you to decide based on the specific industry, growth-potential and other variables.

Here's an example. The Doe Manufacturing Co is building a new plant. A 2000-kva load is expected the first 12 months with another block of 2000 kva to be added shortly after the first operating-year. There are no firm plans for expansion beyond this point. But in light of growth-potential the power-service engineer plans for a possible ultimate of more than double the 4000-kva installed-capacity. But he doesn't put in capacity for some 8000 kva; simply plans how such a load could be handled economically and integrated into the existing system, if and when growth warrants. There probably would be some added investment initially, possibly to provide greater IC in key-switchgear, more physical space for expansion, extra ducts, conduits.

Major system components—transformers, switchgear, cables, circuit breakers—are added to the system as needed by carefully following a master ultimate plan.



FOR YOUR PTG PLANNING:

We tapped the best brains of the industry

An in-plant electrical system that has the power to grow will, of course, follow good current design, as summarized, for example, in "Today's Electrical Practice" (POWER, Oct 1953, pp 73-124). But these basic principles must be applied with a special eye to providing the flexibility needed for economical expansion in the future.

To bring together the latest and best thinking on these special problems of planning for growth, we have been holding a series of meetings with leading engineers of industrial companies, consulting firms and electrical manufacturers.

Detailed data gathered in these consultations will appear in the articles to follow. Right here, it might be interesting to summarize some general conclusions drawn from these PTG sessions.

Most important is solid confirmation for our thinking that power to grow is imperative if industry is to take full advantage of the growth climate in coming years. If anything, the problem is more pressing in small and medium-sized plants.

New loads, growing out of new products and processes, promise to make PTG even more vital than present forecasts indicate.

And we heard endless confirmation of the high cost of neglecting PTG planning.

In future months, each article will bring you look-ahead thinking

In coming articles of this editorial program, we plant to explore each of the technical areas of the in-plant electrical system: primary substations, primary distribution, secondary substations, secondary distribution. In each of these areas, we'll look into the PTG angles in selecting and installing transformers, switchgear, circuit breakers, fuses, relays, cable, duct, troughs, bus-duct, overhead lines, and other elements of the distribution system.

Most articles in the series will follow a 3-part pattern. First will come a quick recap of what is considered good current design practice in the specific technical area being explored. Second part of each 3-part article will consider in detail the special problems and solutions of power-to-grow design. The third part will present a case illustrating how forward-looking planning has been applied in an actual plant and how it has paid off.

The need for power to grow will develop in all kinds of plants. We have already mentioned that it may be most pressing in small and medium-size plants. For this reason, our articles will give special attention to their specific problems.

We should make it clear also that PTG is important to commercial buildings, institutions, and service establishments of all kinds. While we have talked here of the growth forces working to boost industrial production, the same forces bring commercial build-

PTG ENGINEERING CONFERENCE brought the editors together with top-flight industrial electrical engineers and consultants. Aim: To discuss the special factors that must be considered in planning a system with power to grow

on building PTG into new or modernized in-plant electrical systems

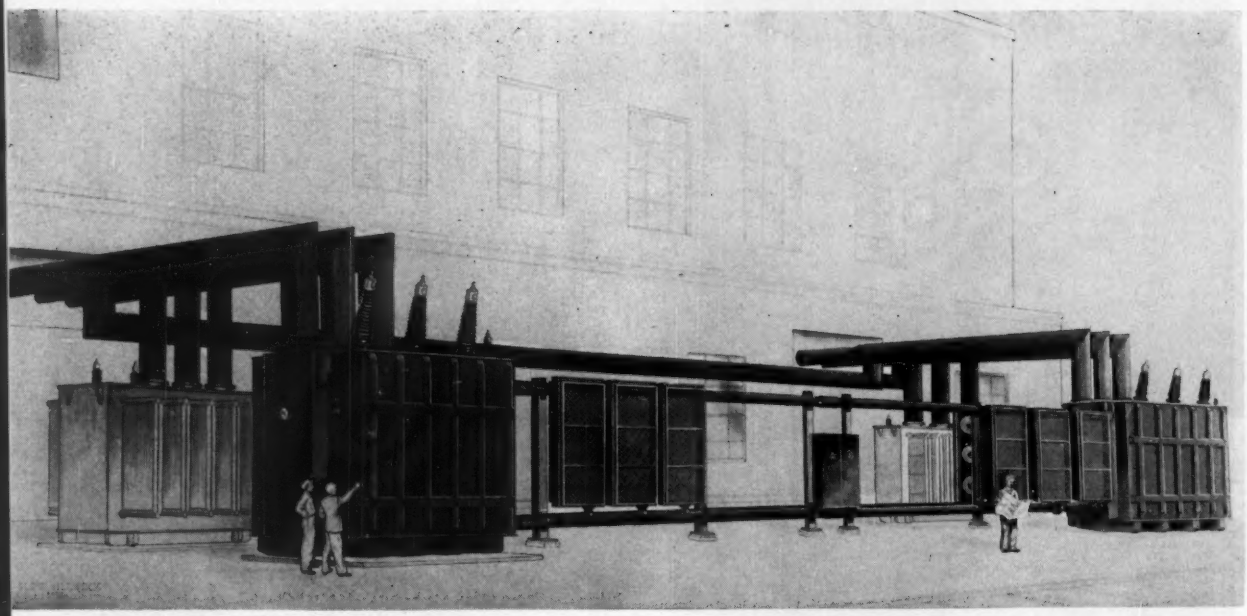
ings and institutions face to face with similar growth problems.

Technical problems, too, are similar in many ways. The modern commercial building, for example, can be viewed as having an electrical system that differs from an industrial one mainly in the fact that it extends vertically rather than horizontally. Certainly, the thinking that helps build power to grow into industrial electrical systems will help to give service establishments the PTG they need.

This editorial program, bringing together the best thinking of the electrical industry, will thus form a comprehensive guide to modern electrical design, with flexibility and expandability uppermost in mind.

Do you have an example of PTG?

Examples of topnotch planning for power to grow will be included in future articles dealing with specific parts of the in-plant electrical system. Your new or modernized setup might well be such an example. Size isn't important and all types of plants—industrial, institutional or commercial—will be considered. So, if you believe the planning that went into your electrical system emphasized PTG, write directly to J J O'Connor, Managing Editor, POWER, 330 W 42nd St, New York 36, N. Y.



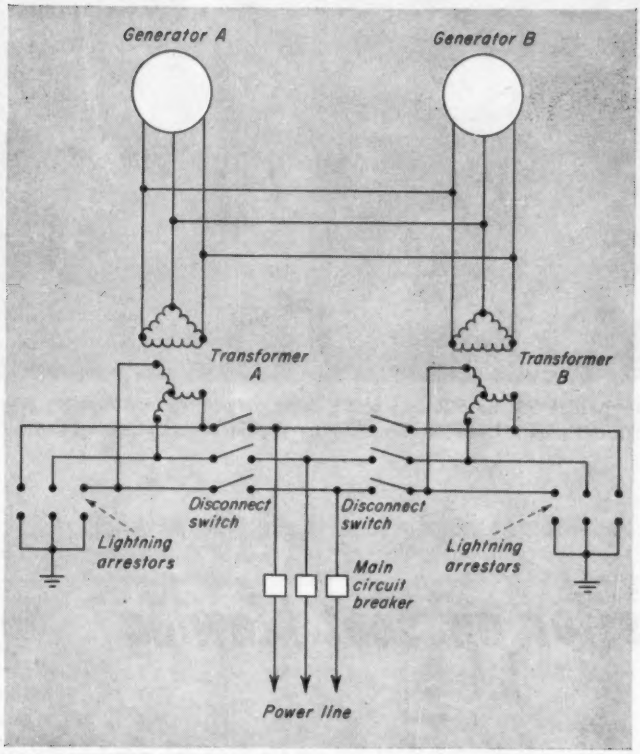
TRANSFORMER AND COOLER arrangement for Eddystone Station has coolers in two banks and valves in interconnecting pipes

New cooling hookup lets one transformer carry 175% load in emergency

Interconnected forced-oil cooling system for two main power transformers at Eddystone Station of Philadelphia Electric Co is so designed that all coolers can be connected to one transformer

► A NEW COOLING SYSTEM will be used for the two main power transformers of Philadelphia Electric Co's new Eddystone Station. The system was designed by Allis-Chalmers Manufacturing Co as a new approach to the safe overloading of transformers. It will enable one transformer to carry a good chunk of normal load of both transformers continuously if the other is disconnected for maintenance or repair. Forced-oil cooling is employed with banks of heat exchangers mounted away from the transformer tanks. Interconnecting pipes and valves make it possible to use all the heat exchangers to cool one of the transformers.

The two transformers are paralleled on both sides. In order to remove either of the transformers it is necessary to dismantle a section of interconnecting bus. The transformer primaries are supplied from two generators connected in parallel. If one transformer is shut down, both generators feed the remaining transformer, and generator load is approximately normal. Each transformer is rated at 200,000 kva for normal



ELECTRIC INTERCONNECTIONS of the two main power transformers permit removing one and letting both generators supply the other

operation. When one transformer uses all the cooling it will carry 350,000 kva continuously. Delta-wye connection is employed to stepup voltage from generated 19.8 kv to 145 kv for transmission.

Tentative arrangement, shown in artist's sketch on facing page, is with main power transformers at ends. Primary bus from generators is interconnected outside building. Coolers (heat exchangers) are located in two banks between transformers. Normally, each transformer will operate with adjacent bank of coolers, and with valves in lines between cooler banks closed. When it is necessary to remove one transformer from service the valves can be opened in the lines between the cooler banks and closed on the end from which the transformer is to be removed. Control cabinet is at center of arrangement.

Cooling system has advantages that recommend its adoption by other installations. The principal advantages are:

1. If one transformer should fail, both generators would still share the load and full generating capacity could be utilized. Each transformer, in effect, is a standby for the other even while carrying its normal load. This reduces the standby transformer capacity required in the power plant.

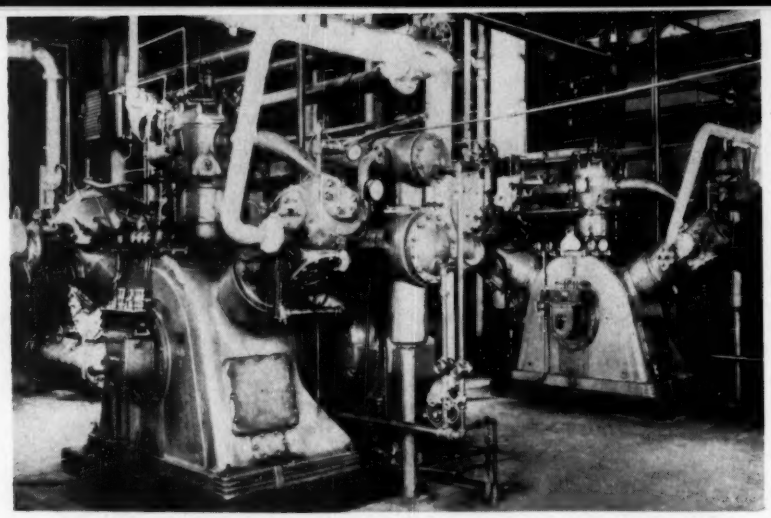
2. Provides continuous operation during the period required for repair of the faulty transformer. Although such failures are rare, when they occur, repair time is long, and transformers are out of service for months.

3. Gives greater reliability to 3-phase transformer installations. Many engineers are reluctant to install 3-phase transformers instead of banks of single-phase units because a fault in one winding of the 3-phase transformer puts the entire transformer out of operation. A spare, or standby transformer must be kept for a 3-phase transformer instead of for a lighter weight, less expensive single-phase unit. With the new cooling system a normally active transformer is the standby and less idle equipment is needed to provide continuity of service.

4. Makes practical the use of one set of lightning arrestors. (System installed at Eddystone Station uses one set of lightning arrestors located between the transformers).

5. Lower costs than some alternative arrangements. As noted above, this system increases reliability of 3-phase transformers, recommending their use in place of more expensive single-phase banks. In other cases the "firm capacity" (capacity of the combination with one transformer removed from service) can be obtained more economically by an interconnected cooling system than with typical unit-cooled transformers.

Safe overloading of transformers is a problem that is getting a lot of attention these days. Power-service engineers face task of maintaining service regardless of conditions arising from trouble or greatly increased demand. Size of power equipment has been steadily growing and maintaining continuous uncurtailed service with any piece of equipment shut down has become more difficult. General practice has been to have sufficiently large installed capacity so that the largest piece of installed equipment can be disconnected without interrupting or limiting service. With larger equipment, standby units are more expensive. Another consideration is maintenance where again today's larger units increase the shutdown problem. Maintenance shutdowns being of relatively short duration do not ordinarily require as much standby capacity as breakdowns. By providing means for safe overloading of transformers, standby capacity can be built into units carrying normal operating loads. Safe overloading really means more effective cooling, such as the addition of fans to carry heat away from transformer radiators. The new cooling system is a promising solution to safe overloading.



1 Two 3-stage 300-hp 500-psig soot-blowing air compressors installed in a large industrial plant. Units of this type are popular in soot-blowing service today

Picking compressors for air soot blowing

► SINCE 1945, use of compressed air, instead of steam, has had a widespread increase for blowing soot from boiler tubes automatically. Air has many advantages over steam, but during the era of manually operated blowers it was considered economically unsound because manual operation required a large and expensive compressor. With the development of automatically controlled blowing and air storage at comparatively high pressure, the investment in compression equipment has been greatly reduced. And as a result many steam plants have swung to air.

Advantages of air. Either steam or air may be used for an automatic blowing system, but air has these outstanding advantages: (1) Lower-cost lower-pressure low-temperature-uninsulated piping may be employed to conduct air to the blowers. (2) Daily energy requirement for the air-operated system is considerably less than for an equivalent steam system. Result is lower plant fuel consumption. (3) Air is said to be a more effective medium because of its greater density. (4) High-pressure steam remains in the closed boiler-turbine system, thereby reducing substantially the amount of makeup.

In this article we will discuss the compression equipment for soot blowing in large industrial power plants and central generating stations.

Air storage. Air is generally required at the blowing nozzles at about 200 psig. To insure a stable supply to the nozzles, a working receiver of about 100-cu-ft volume is maintained at 250 psig and directly connected to the blowing equipment.

Since the automatic system's demand for air is intermittent and controlled, air storage at pressures from 350 to 500 psig in separate tanks ahead of the working tank, makes it possible to size the compressor for the average air demand per cleaning cycle. Thereby, size and cost of compression equipment are reduced. An automatic reducing valve in the line between the storage and working receivers holds the 250-psig working pressure constant. Fig. 2 shows a typical hookup of the complete compressor-receiver system.

Sizing the compressor. The following example illustrates a method of determining compressor size and receiver capacity:

Example. An installation consists of three sizable boilers. Each is fitted with 20 air-puff-type blowers, which operate intermittently over a carefully timed and automatically controlled cycle. The boiler also has 10 retracting blowers which, to avoid overheating, must blow continuously when in the high-temperature zone. Determine the compressor size and receiver capacity.

Solution. Each intermittent air-puff unit blows 10 times per cleaning cycle. Each blow, lasting one second, requires 100 cu ft of free air. Therefore, the total free-air requirement of the 20 puff-type blowers is 20,000 cu ft. Each of the 10 retractable blowers requires 2500 cu ft per min (cfm) of free air for a sustained period of six minutes, totaling 150,000 cu ft free air. Thus, total air requirement is 170,000 cu ft per cleaning cycle per boiler.

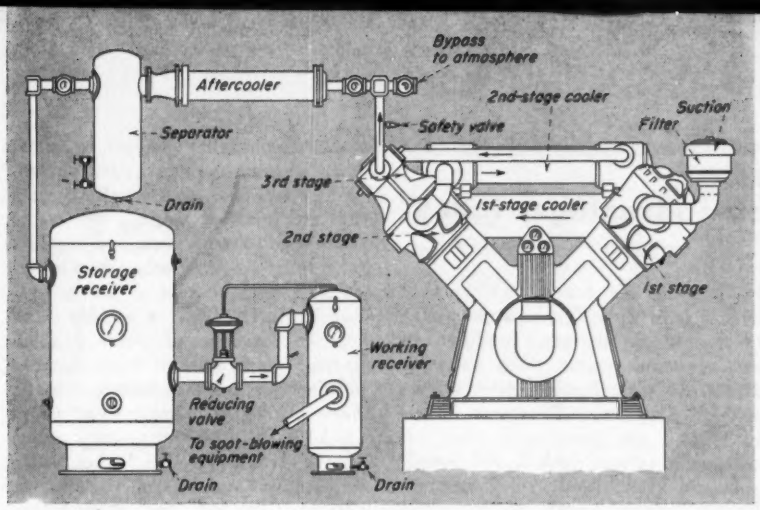
Each boiler is cleaned once every 8-hour shift. Consequently, one boiler must be cleaned every 2.66 hours. Thus the average capacity required of continously operating compressors is 170,000 cu ft/(60 min × 2.66 hr) = 1065 cfm of free air.

Consider that a 500-psig storage system is desired. This system, with the compressor capacity, should be sufficiently large to meet the instantaneous air demands of the blowers without permitting pressure drop in the 250-psig working receiver to exceed a few pounds. Maximum sustained air requirement is the 250 cfm of each retractable blower. This is equivalent to 15,000 cu ft of free air during the 6-min blowing period. During this period, the air compressor puts 6390 cu ft (= 1065 cfm × 6 min) of free air into the system. Thus the storage system must make available an extra 8610 cu ft for the 6-min blowing period.

Based on maintaining the pressure in the working receiver constant at 250 psig and allowing the pressure in the high-pressure receiver to drop to 250 psig at constant temperature, required volume of the 500-psig storage system (assuming sea level) is:

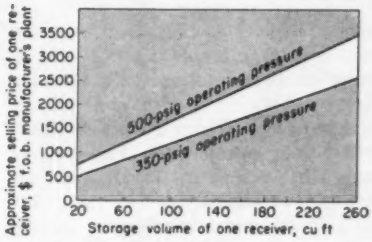
8610 cu ft free air ÷
[(514.7 psia/14.7 psia) − (264.7 psia/14.7 psia)] = 506 cu ft.

If a 350-psig system were elected for



2 Typical compressor and receiver arrangement for an air compressor serving a soot-blowing installation. Note the working receiver, used to feed blowers

Photos and data courtesy of Compressed Air and Gas Institute



3 Approximate selling price of receivers used in air-soot-blowing units

1: Approximate selling price of large synchronous-motor-driven air compressors for soot-blowing service

350-psig final discharge pressure				500-psig final discharge pressure			
Piston displacement, cfm[2]	No. of compression stages	Driving motor, hp	Selling price, $[1]	Piston displacement, cfm[2]	No. of compression stages	Driving motor, hp	Selling price, $[1]
730	2	175	$20,000	635	2	175	$19,600
884	2	200	21,400	779	2	200	21,300
1070	2	250	24,400		(3-stage compression is normally recommended for ratings above 200 hp)		
827	3	200	22,000	686	3	200	21,900
1300	3	300	31,000	1050	3	300	30,600
1618	3	400	38,100	1488	3	400	37,800

[1]Approximate selling price includes compressor complete with suitable intercooler(s) and an aftercooler, automatic compressor capacity control, metallic piston-rod packing, suitable air-intake filter, standard open 440-v 3-ph 60-cycle unity power factor synchronous driving motor of indicated horsepower rating, suitable standard open motor-generator exciter set with starter and standard floor-mounted magnetic full-voltage synchronous-motor starter. Price is fob manufacturer's plant.

[2]For approximate free-air capacity (fac) of these compressors, use formula:— fac, cfm, at compressor suction conditions = piston displacement, cfm x volumetric efficiency, %. Volumetric efficiency varies with specific field conditions and individual units. For average conditions it is 0.72 for 2-stage compression 350-psig final discharge pressure, 0.70 for 2-stage compression 500-psig final discharge pressure and 0.79 for 3-stage compression 350- or 500-psig final discharge pressure.

2: Power required to compress air

Final discharge pressure, psig	No. of compression stages	Bhp per 100 cfm of free air
350	2	33.0
350	3	31.0
500	2	38.5
500	3	35.0

the same conditions, the required storage volume would be:
8610 ÷ [(364.7 psia/14.7 psia − (264.7 psia/14.7 psia)] = 1266 cu ft. With such large storage volumes, the demands of the puff-type blowers are no problem. For example, a puff of 100 cu ft in one second would decrease the air pressure of the 500-psig system calculated above less than one percent. If desired, the interval between puffs can be timed to permit the receiver to be restored to full pressure after each puff. Here, the time interval would be slightly less than five seconds. (The compressor pumps continuously at the 17.75-cfs rate, even while the blower is operating.)

Compressor and storage-receiver capacities as determined above are, of course, minimal. They should be increased reasonably to insure a conservative system. Note that most of the larger plants spread the required compressor capacity over two or three duplicate units, thereby guaranteeing a supply of air at all times.

Selecting the pressure. In an actual case, the manufacturer of blowing equipment can readily provide the air demand and its time cycle. Once this demand is established, the next step is to select the air-compressor plant. Fundamental to this selection is the decision on storage pressure. Note that most of the larger systems are designed to compress and store air at either 350 or 500 psig. Further, unless air is actually needed for a certain blowing application at a pressure in excess of 250 psig, the selection of storage pressure is predicated upon economics and operating preferences.

Compression of a given quantity of air to 500 psig requires about 12 to 17% more power than to 350 psig. Cost of the compressor and storage tanks per cu ft of air compressed and stored are also increased. However, these factors may be more than offset by the smaller compressors and receivers made possible by choice of a 500-psig system.

Table 1 and Fig. 3 are helpful in evaluating and selecting system pres-

Air soot blowers offer many advantages today

sures. Table 1 gives approximate size and selling price of larger 2- and 3-stage compressors, specifically intended for soot-blowing service and proportioned to load driving motors of standard ratings quite closely. Fig. 3 shows approximate cost of ASME *Code* air receivers designed for 350- and 500-psig actual operating pressures (safety-valve settings 10% higher). These prices include usual receiver fittings, such as safety valves, pressure gage, drain and inspection openings. Prices of such receivers may vary significantly throughout the country, so the curves should be used as conservative estimates. The working or ballast receiver, generally about 100 cu ft in volume, is designed for 250-psig operating pressure and sells for about $1000.

Two or three stages? Another consideration in selecting compression equipment is the question of two vs three stages of compression. This question involves initial and operating costs and the operating temperatures of the cylinders. Costs are readily determinable. The relative initial costs of 2- and 3-stage compressors may be judged from Table 1. Average and approximate power requirements, stated in brake-horsepower input to compressor crankshaft per 100 cfm of free air actually compressed and delivered, are summarized in Table 2 (sea-level elevation assumed).

Cylinder operating temperatures are less tangible. Moderate operating and actual air-discharge temperatures are desirable since the lubricant performs better, thereby insuring longer life and lower maintenance. In addition, actual air-discharge temperatures lower than the lubricating-oil flash point minimize the hazard of a fire or explosion in the air coolers or discharge-piping system.

It is, of course, possible to calculate the theoretical or isentropic discharge temperature of a given compressor operating under specified conditions. However, the actual discharge temperature is more difficult to predict since many factors affect it, including cylinder diameter, rotative speed of the machine and many field variables like cooling-water temperature. The cylinder diameter has considerable effect on actual temperature of air leaving the cylinder—the greater the diameter, the less effective the cylinder's cooling jacket.

Thus, in actual practice we find a 50-hp watercooled unit comfortably compressing air from atmosphere to 500 psig in two stages, whereas a 500-hp machine for the same conditions of service would require three stages to avoid excessive heating of cylinders and discharge air. Recommendations in Table 1 are conservative. For certain motor ratings, both 2- and 3-stage units are available. In this range, selection depends largely on economics and preferences based on experience. Note that 2-stage units in sizes larger than those in Table 1 are not normally recommended for either 350- or 500-psig service.

Installation. Referring to Fig. 2, the required compressor accessories and their arrangement are quite conventional except for the addition of the working receiver and the reducing valve between the storage and working receivers. The usual advice applies to these accessories. A quality air filter should be used with large and direct piping between it and the cylinder. If the filter is outdoors have it fitted with weather hood or louvers to keep out rain and snow. The aftercooler should be as close as possible to the compressor discharge to minimize the length of hot-discharge piping.

Receivers, which should be ASME *Code* constructed and inspected, should be piped so air flows through both storage and working receivers. It is poor practice to have an arrangement whereby a single pipe is connected from the main transmission line to the receiver so full air flow does not pass through the receiver. Besides these fairly routine considerations, certain points in installing and operating the soot-blower compressor deserve close attention.

The compressor should be fitted with automatic capacity control to adjust machine output to air demand. If anticipated demand is quite constant and the compressors are selected to meet the demand with little excess capacity, simple constant-speed cylinder unloading control is probably sufficient. With this control, however, wide variations in demand could cause the compressor to run unloaded for long periods, thus wasting power. Such a condition warrants automatic start-stop control. This causes the compressor to shut down when receivers are fully charged and to restart automatically when storage pressure begins to drop.

A good and only slightly more expensive arrangement is dual control, which permits the operator to select either constant-speed cylinder unloading or start-stop operation. Both processes are fully automatic.

Cooling. Temperature of cooling water entering intercoolers and aftercoolers should be kept as low as possible—in intercoolers, to achieve maximum condensation of water and oil vapors. Temperature of water entering the individual compressor cylinder, however, should be maintained about 5 to 10 F above air temperature entering the cylinders. This higher water temperature, which avoids condensation of saturated air entering the higher stages of compression, does much to protect cylinder lubrication and lengthen compressor life. Liberal use of thermometers in air and water lines greatly assists operators in maintaining correct temperatures and checking daily operation of the unit.

An excellent protective device is a thermostatic switch. Installed in the final air-discharge line at the outlet of the last compression stage, it is arranged to sound an alarm or shut down the driving motor whenever discharge temperature becomes excessive. Such a device guards against cooling-water failure and malfunctioning of compressor valves. Thereby it protects against the possibility of scored cylinders and discharge-line fires.

Adequate draining, of separators on intercoolers and aftercoolers and also of the receivers, is important. If condensate is allowed to accumulate in the intercooler separators, it may be pulled over into the higher stages of compression, washing away the lubricant and thus causing excessive cylinder wear. An accumulation of condensate and oil in the aftercooler separators and receivers is to be avoided since it may lead to fires in the discharge system. Generally, intercoolers are fitted with automatic drain traps. The higher-pressure aftercoolers and receivers are either automatically or manually drained depending on their location and the preference of the purchaser.

Likewise, the entire discharge-system piping should be designed to avoid loops and pockets where lubricating oil might accumulate. If such points are required, drains should be provided and these, too, should be opened periodically. Occasional dismantling and cleaning of the discharge line between compressor and aftercooler is good practice. The discharge system should be carefully checked to make sure there are enough safety-relief valves. In addition to safety valves, some users like to fit the storage receivers with safety heads.

1—Some radiation hazards created by impurities in primary-system water

Undesirable elements	Tolerable quantity[1] oz, approx	Isotope formed	Half-life, approx	Principal gamma radiation	Activity per gram reached in 10^{14} neutron flux, d per sec, approx	Effect on accessibility after shutdown (external radiation)
Flux from welding electrodes						
Calcium	10 or less	Ca-49	8.5 min	Brehmstrahlen plus hard gamma	10^{9}	Substantial
Fluorine	10 or less	F-18	110 min	0.5 mev (annihilation)	10^{10}	Substantial
Silicon	10 or less	Si-31	2.8 hr		10^{8}	Substantial
Oil or grease from inadequately cleaned tools, gages, pumps, valves, etc						
Carbon		C-14	5000 yr	None		Unimportant
Untreated water and general dirt						
Sodium	1/20	Na-24	15 hr	2.76 mev[2]	10^{14}	Substantial
Potassium	10	K-42	13 hr	1.5 mev	10^{11}	Substantial
Chlorine	10-100	Cl-34	33 min	3.2 mev[2]	10^{9}	Substantial
Materials left after careless cleaning of primary systems						
Aluminum	10	Al-28	2.25 min	1.8 mev	10^{13}	Substantial
Copper	1	Cu-64	13 hr	1.35 mev	10^{13}	Substantial
	1	Cu-66	4 min	1.05 mev	10^{12}	Substantial
Silver	1	Ag-108	2.3 min	0.6 mev	10^{12}	Substantial
		Ag-110	27 days	0.6—0.7 mev	10^{12}	Substantial
Zinc	100	Zn-69	13 hr	0.45 mev	10^{7}	Unimportant
		Zn-71	2.2 min	Brehmstrahlen	10^{8}	Unimportant
Cadmium	10	Cd-115	2.3 days	0.3—0.5 mev	10^{11}	Substantial

Chromium, nickel, cobalt, manganese—unimportant as radiation hazards unless present in soluble salts.

[1]Based on 4000-gal-capacity primary system. [2]Quite hard gamma radiation

Note: This table does not indicate mechanical or corrosion problems that impurities may cause. Effects listed relate to radiation problems only.

Maintaining nuclear reactor plants: 2

Conservative approach during construction avoids operating headaches later on. Both manufacturer's shop practice and field-force methods must be geared to rigid specifications

By R E CREWS and J M YADON
Westinghouse Electric Corporation

► SETTING CONSERVATIVE STANDARDS for any new project and later relaxing them as operating experience warrants is a prudent attitude. Erection contractors and their workmen usually approach a job's problems on the basis of their previous experience.

Many of the nuclear-plant requirements are new to a contractor so he should be thoroughly informed on the reasons for the special procedures specified. Let's talk about some of these.

Equipment inspection. For the next several years, much of the apparatus and materials for nuclear plants will be fabricated by manufacturers who have had little or no experience in this field. Even with detailed plans and specifications we find it difficult to obtain items completely satisfactory. Standard shop methods and quality-control satisfactory for conventional equipment are not suitable for many nuclear-plant components.

Later difficulties may be caused by failing to keep all components of an assembly *absolutely clean*—for example, sand in castings, machine chips and filings, oil films, foreign matter. Other troubles have been imperfect welds and weld materials, imperfect seating surfaces for metal gaskets and inaccurate machining for close-fitting parts.

We find that a well-organized and trained inspection group saves both time and money by examining all equipment on arrival at the plant site as opposed to storing the apparatus on receipt and later discovering that it must be dismantled or returned to the supplier for repair. An engineer familiar with the components and working closely with the inspectors can determine component acceptability without dismantling them. We do this by using boroscopes and mirrors on many of the more complicated components.

Construction inspection. If plans and specifications are accurately detailed, one chief inspector (per shift) who knows the needs can supervise a group of inspectors experienced in conventional construction.

A few well-organized lectures with illustrations and demonstrations will indoctrinate inspectors who will not eventually stay in plant operation. An intensive educational program for these men would probably not pay.

If conditions permit, integrate future plant operating and maintenance personnel into the inspection group. This strengthens the inspection force and gives the plant men first-hand knowledge of their equipment, adding valuable background for later operation.

Deviations from plans and specifica-

tions, permissible on conventional jobs, are often unacceptable for nuclear plants. For example, substituting materials of equal strength and general physical properties for those specified might cause trouble because the substitute corrodes or erodes in high-temperature pure water, or might deteriorate in a high-radiation flux. Of greater importance, radiation of the substitute might produce very long half-life isotopes that would seriously hamper later accessibility or effluent disposal.

Table 1 lists a few isotopes that can be formed in substitute materials containing the substances listed. This depends on the substances entering the coolant and being exposed in the reactor core. Construction plans and process specifications must be followed strictly with no substitution of materials allowed or attempted.

Rigid inspection should also be made of systems using magnetic amplifiers and other types of very sensitive instrumentation, and control circuits operating on very low signal power. Electrical interference and signal pickup becomes important in these circuits, so carefully designed shielding arrangements must be strictly observed for troublefree operation in the future.

Cleanliness. Filters and strainers usually keep foreign material out of critical apparatus in conventional hydraulic systems. Usually these cleaners cause no trouble in clearing a normal amount of foreign matter from a system and its components.

Nuclear power plants use filters and strainers too. But the serious results of foreign matter, getting into a "canned pump," a cylinder-operated valve or the reactor core, make filters and strainers impractical in the primary reactor loop. Instead, during construction, the loop must be kept *completely clean* of all foreign matter including: grinding dust, weld splatter, slag, chips, dust, lint, paper, cloth and liquids. A large filter in the reactor vessel is used initially (and during refueling) to flush and filter the primary system before installing the fuel assembly.

If the materials in Table 1, p 87, were left in the loop, and became radioactive, they would form "hot" spots wherever they lodged. They might eventually dissolve and be removed by the purification system, but this might take many months of operation. Should material lodge in a low-flow area of cold "dead-end" pipe, it could only be removed by dismantling.

Inaccessible system. Proper installation is more important in a nuclear-plant than in a conventional one. Inaccessibility of the primary system during operation means that all systems within the radiation shield must be run remotely. The plant must be shut down to make repairs within the shield.

Special materials. On the whole, the erection contractor will be working with materials and processes generally known and used in other industries. However, a few of the very special materials and processes in nuclear-plant erection are used only in a few highly specialized industries. The contractor should be told of any special materials and processes involved so that he can train his workmen to do the job properly.

Maintenance practice. Experience has shown that maintenance can be done on a nuclear power plant without abnormal risk to personnel and without undue time and cost, provided personnel are thoroughly qualified. Even in the beginning of nuclear power plant operation we found that more than 80% of nonroutine maintenance and repair items involved conventional equipment. Typical problems include common items, such as loose connections, manufacturing errors, and foreign matter in mechanical systems.

Protection against radiation exposure complicates all service and maintenance practices. As emphasized by Wagner in "Reactor Maintenance Problems," *Electrical Engineering,* March 1955, p 221, many new techniques and special tools are being developed to assist in maintenance work where radioactive materials are encountered.

With proper shielding, no protective clothing is needed by personnel working outside the shield, even with the plant running at capacity. Also, unless the area inside the shield has been contaminated by a coolant leak, maintenance work can be done after shutdown without elaborate protective clothing.

Precautions against contamination must be taken when opening the coolant system. A workman entering the shielded area during a shutdown should wear shoe covers and coveralls that he removes and are collected as he leaves the area. This practice reduces the possibility of minute quantities of radioactive materials being transferred to critical areas, such as cafeterias, offices and other locations where there must be no contamination.

Maintenance time. Table 2 outlines the estimated man-hours needed for maintenance of a 40-60-mw-heat rating reactor. Standard equipment associated with the primary plant, such as switchgear, valves and circulating pumps, are included as a group under the heading Standard Equipment. In general, the apparatus listed is peculiar to the nuclear plant. Provisions for secondary steam plant maintenance are not included.

Table 2 does not include such service personnel as the following: industrial-hygiene technicians, test engineers, clerical help, building janitors. The only personnel included are those actually doing or supervising maintenance work. Based on these data, about 60,000 man-hours per year would be needed for primary plant maintenance. This may be much in excess of the maintenance man-hours for steam generation in a conventional plant, but for the next few years the nuclear power plant will still be in the early development stages. As experience is gained, this time may be materially reduced.

We will make no attempt to outline the requirements for a maintenance crew as there are too many variables that determine the basis of crew organization. Some of the influencing factors include use of (1) outside maintenance contractors (2) operating personnel for maintenance work (3) union agreements covering maintenance work.

Preventive maintenance should be conducted on a well-organized schedule to minimize operating failure. During operation, certain components and auxiliary systems can be taken out of service for maintenance if the operators can anticipate a situation and make appropriate adjustments. Practically all automatic and remotely controlled features of a plant can be transferred to manual control. This allows for maintenance work on bypassed units.

Operating logs and trouble reports to predict nonroutine maintenance and repair work should be used extensively. For instance, reports of slow response of hydraulically operated components may indicate partly plugged strainers or filters, or a malfunctioning pilot valve. Certain abnormal conditions in the primary loop can often be detected by secondary indications or abnormal conditions in the auxiliary systems. Other adverse conditions like excessive pure-water leakage can be determined by increased level in leak-collecting flasks or increased charging requirements. Remote viewing devices permit visual inspection of primary apparatus within the shield. Loose equipment, discolored lagging or cable, water or steam leakage may be discovered while the plant runs.

Many preventive maintenance practices already well-known in conven-

tional plants can be used in nuclear plants. Cleanliness and good housekeeping are of utmost importance. An adequate preventive maintenance program for mechanical equipment will, among other considerations, include: preventing leaks, keeping equipment clean, lubricating, adjusting and calibrating apparatus.

For electrical equipment, the program will cover: general cleanliness, proper adjustment and calibration of apparatus, high insulation resistance. Nuclear instrumentation components, in particular, need very high insulation resistances, up to 10^{13} ohms.

Repairs. Before taking any component out of service for maintenance, a previously prepared procedure should assure that associated systems and components will not be affected adversely. The maintenance procedure must provide the workman with sufficient detail to enable him to work on the apparatus and prevent him from causing trouble in other areas. For example, such a simple task as an electrician replacing a damaged switch can scram the reactor and shut the plant down if proper jumpers are not installed.

For repairs inside the shielded area, care is taken to insure adequate protection for the workmen. Before entering the area, a survey must be made to determine the degree of air-borne contamination. With the reactor shut down, and with no coolant leaks, the area will ordinarily be safe for work without gloves or respirators.

Even after a nominal coolant leak, the ventilation system will generally clear the atmosphere by the time the plant has cooled and mechanics are ready to work. Usually, external contamination from coolant leaks can be cleaned up by several wipings with clean, dry cloths. In a highly contaminated area, it may be necessary to send workmen into the area to clean up in rotation. Sometimes, temporary shields may be needed to reduce ambient radioactivity level.

Cutting or grinding usually is needed to remove components from the sealed systems. Metal chips should be kept within the working area so they can be removed easily and completely. The work area should be intermittently or constantly monitored, depending on circumstances. If the component being removed has been drained of primary water, the radioactivity probably will have decayed to a safe level by the time piping and mountings have been disassembled.

The worst contamination problem arises during disassembly of a component that has been in the system for a long time and has accumulated radioactive corrosion products in its closely fitting parts and recesses. In such a case, every precaution for personnel safety is used. The industrial hygiene group should supervise each step of the disassembly procedure.

The third and final part of this series will consider some of the special tools developed for nuclear-plant maintenance—in a forthcoming issue.

2—Typical maintenance man-hour needs for pressurized-water nuclear power plant°

System or component of nuclear-plant	Man-hours for routine service and maintenance						
	Daily	Weekly	Monthly	3 mo	6 mo	Yearly	Remarks
Canned motor pumps			1				Per pump, megger rdgs
Positive-displacement-type pumps					8		Per pump, routine
Cylinder-operated valves						100	Note 1
Solenoid-operated valves						60	Note 2
Manually operated valves				20			Note 3
Relief valves			2				Note 4
Filters and strainers						100	Note 5
Demineralizers					48		Per unit, recharging
Reactor control system	8	16	100		500	1000	Note 6
Auxiliary controls and instrumentation	8	16	200		1500	2000	Note 6
Temperature monitoring system			32				Note 6
Control rod drive mechanism						500	Note 7
Rod-motor generator sets			2				Per set, routine
Pressure transmitters, differential pressure cell				4			Note 8
Valve position indicators						4	Per unit, calibration
Immersion heaters		8					Note 9
Radiation monitoring system		8					Note 6
Thermostats and couples			48				Adjust, replace
Pressure gages						2	Per gage
Pressure switches						2	Per switch
Standard equipment						9000	Per gage
Cleaning, painting	32						

Note 0: Refueling operation and steam plant maintenance are not included. Table based on 24 hr per day, 7 days per week operation.

Note 1: These valves are generally welded completely and no routine maintenance is needed. Based on 4- to 6-yr average valve life, 100 man-hours per valve per yr is allowed for replacement.

Note 2: For mechanical maintenance Note 1 applies here, but 50 man-hours per valve is allowed for replacement and 10 man-hours for electrical work.

Note 3: 20 man-hours per valve per quarter is a weighted average. Some valves need no attention for over a year, but others require repacking, replacing of internals or complete replacing depending on use.

Note 4: Testing. To date considerable repair and maintenance are needed on these valves, but valves applied to presently operating plants are complicated by requiring blowdown characteristics for submarine duty (variable backpressures). Relatively trouble-free valves should be available for surface ships and generating plants.

Note 5: No routine maintenance is done on strainers and filters since backflushing should keep unit in running condition indefinitely. To date, occasional operating conditions have made it necessary to replace or repair these units.

Note 6: Routine maintenance and calibration.

Note 7: Normally no maintenance needed between shutdowns. 500 man-hours per yr included as contingency for operating errors and incidents.

Note 8: Per unit, no routine maintenance is needed. But instrumentation alignment sometimes calls for "zeroing" the transmitter. Mechanical failures almost always result from operating errors.

Note 9: Per bank; megger readings and replacement.

- **When they are properly installed and maintained, flame-failure safeguards are reliable**
- **But there are limits to what they can do. They must be backed up by other safety interlocks, and they are no substitute for alert, well-trained operators. Here are five viewpoints on . . .**

What you can expect from today's flame-failure safeguards

Having gained wide acceptance on single-burner package boilers with full automatic controls, combustion safeguards are now finding a place on large multi-burner manually started units.

The five letters that follow show where and how these devices are used to help reduce explosion hazards, and indicate future trends in development.

Factory Mutual Engineering Div

Approved flame-failure safeguards are definitely worthwhile. You can expect good service when an approved unit is properly installed, maintained and applied within the limits the manufacturer sets.

The Approval Standards of the Factory Mutual Laboratories states that four seconds is the maximum permissible retard on responding to flame failure. There is no minimum response time, so almost instantaneous action is acceptable.

Formerly these standards had a 2-second minimum to avoid nuisance shutdowns from harmless flame variations. Faster response is now practical.

The flame safeguard is only part of the system that shuts off fuel. The fuel safety shutoff valve's closing time must also be added. Response time for approved valves must not exceed five seconds.

While many approved valves close almost instantly, certain slow-opening types require a few seconds.

Minimum acceptable flame-safeguard response time depends on factors like electronic-circuit characteristics, relay inertia equipment susceptibility to shock or vibration, characteristics of burner. The fastest response time on approved safeguards that we know of is 0.8 seconds.

For most installations there is no practical reason for requiring a built-in adjustment of response time. Where this might be desirable under unusual conditions, the design would have to prevent lengthening the response time to over four seconds.

Proper maintenance is important. Follow manufacturer's instructions. Also, check operation by simulating flame failure. Test periodically to determine that the fuel safety shutoff valve closes tightly.

Furnace fuel explosions are caused by (1) flame failure during normal operation (2) light-off attempts with insufficient purging of the combustion chamber, inadequate or wrongly placed pilot or torch, overlong trial for ignition or repeated ignition attempts without purging. Other important causes are improper fuel-air ratio, too-low oil temperature or steam-atomizing pressure, leaking valves, improper soot blowing, etc.

Flame failures nearly always occur while firing with only one burner at low ratings (below 30%)

Power's questions on combustion safeguards

► Back in November 1955, Power published a letter from F H Valentine of Cleveland, Ohio, giving his opinions on the cause of a boiler explosion at the Euclid Senior High School. One thing he mentioned was the need for instantaneous and positive shutdown in a flame failure.

Shortly afterward, another reader wrote in, suggesting that we look into the uses and scope of flame failure safeguards available on the market today.

We wrote insurance companies, boiler manufacturers and flame-failure safeguard manufacturers to get their views. Our questions covered these points:

Are flame-failure safeguards worthwhile? What kind of service can you expect from them? What are the time-delay limits for effective action?

Are flame failures the usual cause of furnace explosions, or is there some other cause or causes? Do explosions usually occur as often on boilers with flame-failure safeguards as on those not so equipped? Is it practical to make safeguards adjustable? What sort of maintenance is required? What other safety controls and interlocks are necessary?

Pertinent comments on these questions are printed above.

either for low loads or while warming up shortly after lighting off. Under these conditions furnace temperature is below the prompt reignition temperature for the fuel.

Other safeguards for minimizing fuel explosion hazard include interlocking the main safety shut-off valve with electrically driven draft fans, where continuous fan operation is necessary for proper combustion at all firing rates. Interlocking should require placing the induced draft fan in operation, then the forced draft fan, before shutoff valve can be opened. Failure of either fan should shut off and lock out the fuel.

Oil-fired units also require thermometers for measuring oil preheat and pressure gages on the header supplying pressure- or steam-atomizing burners.

Gas-fired multi-burner units need approved burner safety cocks and safety-control system to insure that burner cocks are closed before shutoff valve is opened.

Explosions have occurred in equipment where the safeguards were properly installed and doing all that could be expected. An electronic safeguard cannot protect against poor air-fuel ratio and resulting flammable incomplete products of combustion while there is enough flame to actuate the sensing element.

Combustible-gas analyzer controllers are now available to protect against this hazard. Such equipment is also valuable for operating efficiency.

LOUIS H FLANDERS, *Engineer, Standards Dept*

The Babcock & Wilcox Company

At present, flame-failure safeguards are worthwhile if they definitely assist the boiler operator. But if they cause frequent shutdowns when no flame failure has occurred, they can make an operator nervous and cause him to make serious mistakes when relighting.

Further, the most hazardous time in operating a boiler is while the burner is being ignited and the boiler brought up to load. So the less often the operator does this, the less chance of an explosion.

Our experience with more recent flame-failure safeguards is quite satisfactory. The components seem rugged; their service life compares to other controls.

Burner and furnace characteristics help determine the limit of time delay for effective flame safeguard action. The most successful detectors "view" the flame. Photoelectric cells pick up the luminous part of the flame; photoconductive cells respond to infrared.

If there should be a momentary dark spot in the flame in line of sight, you would not necessarily want fuel cut off. So the equipment needs some time delay. Perhaps two seconds is too long from a theoretical approach. But experience of the many units operating with this delay does not seem to bear this out. Future experience will tell whether time delay can be cut to one second or less and still be practical.

Explosions while flame is being established on the burner have been almost eliminated on modern, water-tube packaged boilers. These units usually have a built-in ignitor system and a programing device that "proves" the pilot flame before admitting fuel to the main burner. Also, a limited time is permitted for igniting the main flame. All fuel is shut off if the main burner detector is not satisfied in this time. Automatic recycling is not allowed if the fuel cut-off occurs as a result of indicated flame failure.

(*Continued on page* 92)

In brief:

How flame safeguards work

Combustion safeguards detect the presence or absence of flame. In a flame failure they sound an alarm (if provided) and may automatically shut off fuel supply to the burner being supervised.

The principal types now used for industrial burners are the flame rod, photoelectric cell and lead-sulfide cell. All operate practically instantaneously. Other types of safeguards, actuated by radiant heat, thermal or thermocouple action, require more time for operation. Usually, they are not considered responsive enough for industrial-size main burners.

Flame-rod safeguards are suitable for main and pilot-burner gas flames. An electrode or rod of temperature-resistant material extends into the flame. The conductive property of the ionized gases in the flame permits a current flow that actuates relays through an electronic or electric circuit. The relays make or interrupt power to a safety shut-off valve.

Electrode must be located so the pilot flame cannot cause a current in the circuit without providing prompt, reliable ignition for the main burner.

Photoelectric safeguards are mounted outside the firebox and sighted on the flame being supervised. They depend on light from the flame striking a light-sensitive cell. When enough light intensity is present, current flows in the cell. This minute current is amplified electronically, actuating relays to make or interrupt power on a fuel safety shutoff valve.

This safeguard is suitable for highly radiant oil flames. It is not generally used on gas because properly proportioned gas flames are nonluminous.

Lead-sulfide cell can be used on nonluminous gas flames and luminous flames of coal and oil. This cell operates on a "photoconductive" principle. Its electrical conductivity varies inversely with the amount of flame radiation received, and it is most sensitive to infrared waves.

One commercial application uses the voltage variations caused by passing a direct current through the varying resistance of the cell. These variations are amplified in an electronic circuit that accepts only voltages with a rapid and continuous pulsation from 5 to 20 cps (the flicker frequency of a flame).

The final detection instrument, therefore, will not register presence of a flame when the unit is actuated only by radiation from hot refractory.

The other two common causes of furnace explosions are flame failures and operation with over-rich fuel-air mixtures. Flame failure causes the vast majority of these explosions, but very few occur while unit operates normally at more than 25% of full output.

All too often, furnace explosions occur on units with flame safeguards because an operator had difficulty with the unit tripping out. Instead of trying to learn why, he bypasses the safeguard to get back into production.

If the safeguard trips only once a year, an operator is more likely to search for the reason than if interruptions occur almost daily. So I doubt that reaction time should be cut much below one second.

We feel that, when boiler operators more generally adopt and accept flame-failure safeguards, the number of furnace explosions on units properly equipped will be much less than on those not so equipped. This has been true of our packaged boiler experience.

We don't think it is practical to make safeguards adjustable. This would invite trouble.

Maintenance is nominal, as safeguard manufacturers will note (below). We have received no serious complaint about the maintenance required.

Other safety measures and interlocks to reduce the number of furnace explosions depend on the fuel. In general, we recommend a purge interlocok so firing equipment cannot be energized until mechanical-draft flow rate is high enough to rid the unit of unburned fuel products. After establishing air flow at the upper value, the interlock permits reducing it to a value safe for burner ignition.

Mechanical-draft equipment should be interlocked so fan failure trips off the fuel. In general, pulverizer-fan shutdown should shut off mill and coal feeder; forced-draft-fan failure should trip out pulverizer and feeder; failure of the induced-draft fan should trip out the forced-draft fan and pulverizing equipment. This also holds for oil or gas.

Oil- and gas-burning equipment should have a low fuel pressure alarm and interlock so reduction in fuel-supply pressure first gives operators a warning. Then if pressure drops dangerously, supply to the burners should be interrupted. If unit has flame-detecting equipment arranged to shut off fuel on flame failure, this interlock may be omitted.

Another device that should gain popularity is the combustibles analyzer. It continually samples flue gas and indicates presence of combustible gas. It can be equipped with an interlock. No present flame detector serves the same purpose of preventing flame from entering the furnace on light off, if a dangerous accumulation of combustible gas exists. Also, it shuts unit down should an over-rich mixture develop during firing. This is especially important on gas-fired boilers.

In general, application of flame-failure safeguard equipment to single-burner, watercooled furnaces is a proven accomplishment. Application on multiburner units is just beginning to gain momentum.

One problem is that unless detectors are aimed very carefully they may pick up the flame from a companion burner and be satisfied when flame from the burner they are supposed to supervise is out.

In certain applications, completely satisfactory flame-safeguard installations can be made to boilers with not more than two vertical rows of burners and steaming capacities at least up to 100,000 lb per hr.

A J POOLE, *N. Y. Staff Engineering Dept*

Safeguards must shut off fuel fast in a

Bailey Meter Company

Flame-failure safeguards are essential on single-burner installations firing oil or gas, with off-on operation and with modulation of fuel and air throughout the turn-down range of the burning equipment.

We limit our application of flame-scanning equipment to a maximum of four burners per boiler. This facilitates locating detectors so they see only the burners they serve. When a detector is applied to a burner handling more than one fuel type, sensitivity and location of the detector may not be suitable for each fuel used. Also, scanning the flame from individual burners without interference from adjacent ones may require designing burner and its arrangement to suit the scanning equipment rather than vice versa.

Each burner monitored by a flame safeguard must have its own fuel shutoff valve and damper. If flame fails, safeguard should close that burner's fuel and air supply.

During the lighting period, flame safeguard must be bypassed until ignition is established. Fuel- and air-supply controls must be opened. This is done best by automatic ignition, and lighting by some type of burner-program control.

If burners use hot instead of low-temperature air, ambient temperature around the safeguard equipment must be considered. The lead-sulfide type of flame detector is probably the best on the market for universal use.

Under ideal conditions, as, for example, with a single-burner packaged boiler, you can expect a year's service without maintenance. But discrimination between individual burners on a large multiburner unit using hot-air supply and firing pulverized coal might prove impractical regardless of amount of service.

Time delay for light-off is necessarily greater than for shutdown. The fuel, length of fuel lines, and time to obtain a stable flame can easily take up to ten seconds or more. On natural gas, however, light-off time may be reduced to three or four seconds.

For tripping burner out of service, a 2-second time delay has proven satisfactory. This represents the delay in tripping the sensitive relay, and does not mean time to trip relay, close fuel-supply valves, and empty lines of fuel.

A one-second minimum is feasible. Faster tripping may cause too many false indications of flame failure.

Insurance company records indicate that the most common cause of furnace explosions is improper light-off—igniting a burner in a furnace filled with combustibles. Furnace explosions can also occur without complete loss of ignition.

Whether explosions happen as often on boilers with flame safeguards as on those not so equipped depends on what is included. Is the "safeguard" merely a signal light or alarm? Does it include automatic programing, lighting and purging? No installation should be set up without proper purging equipment.

Trip-out timing should not be an adjustment for

the operator. But it can be adjusted within certain limits by changing components in the circuit.

Maintenance depends on equipment and operating conditions. Photoelectric and flame-rod units need more attention than lead-sulfide cells.

Life of the electronic components in any unit is influenced by ambient conditions. Units in hot, dirty atmospheres need more maintenance than those in clean, cool atmospheres.

H P LEWIS, *Staff Engineer*

Minneapolis-Honeywell Regulator Company

Flame-failure safeguards are definitely worthwhile. With the widely accepted sequencing of proving a pilot before opening the main fuel valve, then checking the main flame during the running cycle, and providing immediate burner shutdown on flame failure, electronic flame safeguards unquestionably provide the gas- and oil-burner industry with a tremendous safety advance.

There are several variations to this basic sequence, like pre-purge timing, post-purge timing and, on some burners, returning the ignition immediately after a flame failure to attempt re-establishment of the pilot or main flame.

With periodic maintenance, satisfactory operation should be assured for years. Since the introduction of electronic safeguards, many improvements have been made in circuitry, electronic components and flame sensing. Typical circuitry improvements include addition of the automatic component check at the end of each firing cycle and, more recently, component check following each power failure, no matter how long or short the interruption.

Where burners operate continuously, shut down periodically to check safeguard response, and to check for component failure that could simulate a flame. These cannot be checked during the running cycle.

Response timing to a flame failure must prevent nuisance shutdowns, yet shut down a unit safely. If ignition is returned following flame failure, this should be done as fast as possible. Here we have recommended 0.8-second response timing.

To avoid nuisance shutdowns in momentary flame variations, we recommend a two-to-four second response. Requirements of the approval boilers—Underwriters' Laboratories and Factory Mutual—temper our recommendations. Until recently, Factory Mutual favored two-to-four second response. Recently, on some larger burner installations, they have accepted 0.8 second.

Reducing the 0.8-second response timing is possible; but this would undoubtedly increase out of proportion the nuisance shutdowns.

Let's consider shutdown time in another light. For any given installation, divide hourly fuel consumption by 3600 to get fuel flow per second. Add the amount of air required for a combustible mixture. This gives you the amount of combustible mixture that would be introduced into the combustion chamber if the response time to a flame failure were one second. Could that amount of combustible mixture create a hazard?

Today, manufacturers of certain large burners are considering eliminating the post-purge cycle. The thought here is that if flame failure resulted from improper fuel-air ratio, adding air in the purging cycle might create a hazard.

As Factory Mutual's records indicate, the majority of furnace explosions occur during light off, with flame failure during the running cycle less frequent. Burner type and efficiency, fuel, type of maintenance on burners and boiler can all be factors.

We do not believe the approval bodies would favor adjustable response timing. This would allow tampering. Adjustments for one condition wouldn't necessarily apply to all other conditions.

Normal periodic maintenance consists mainly of these checks: (1) Inspect the contacts; be sure dust and dirt don't affect operation. (2) See that flame-sensing devices are in good condition and in proper location to supervise the flame. (3) Turn off the main fuel supply during normal burner operation to check the response timing to flame failure. (4) Replace vacuum tubes as required.

Perhaps equally as important is providing the operator adequate instructions for restarting the burner following any safety shutdown.

C E SWANSON, *Market Manager*

Electronics Corporation of America

Flame failure safeguards' value to users of fuel burning equipment cannot be denied. But they must be intelligently applied, installed and maintained, following burner and control manufacturers' advice.

We recommend maintenance at scheduled intervals, following a specific routine. Keep contacts free of foreign material; check vacuum tubes and replace as necessary. Check that scanner still adequately views pilot and main flame, and that lockout switch and response time to flame failure have not varied.

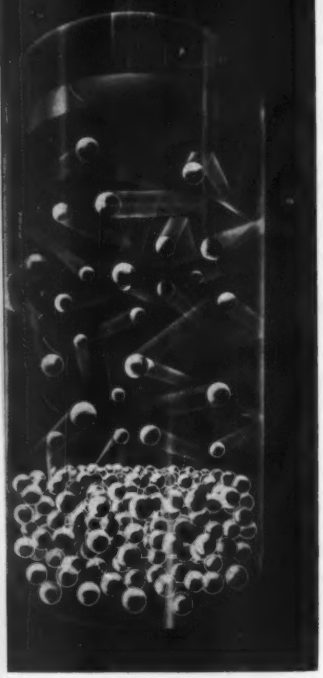
Nominal two to four second safeguard response is satisfactory for most applications. Furnishing shorter response timing only to build up a history of nuisance shutdowns caused by harmless flame fluctuations is not good. Conversely, timing should not approach four seconds if shorter response satisfies safety requirements yet avoids nuisance shutdowns. In some cases, response timing of about one second is possible, even desirable.

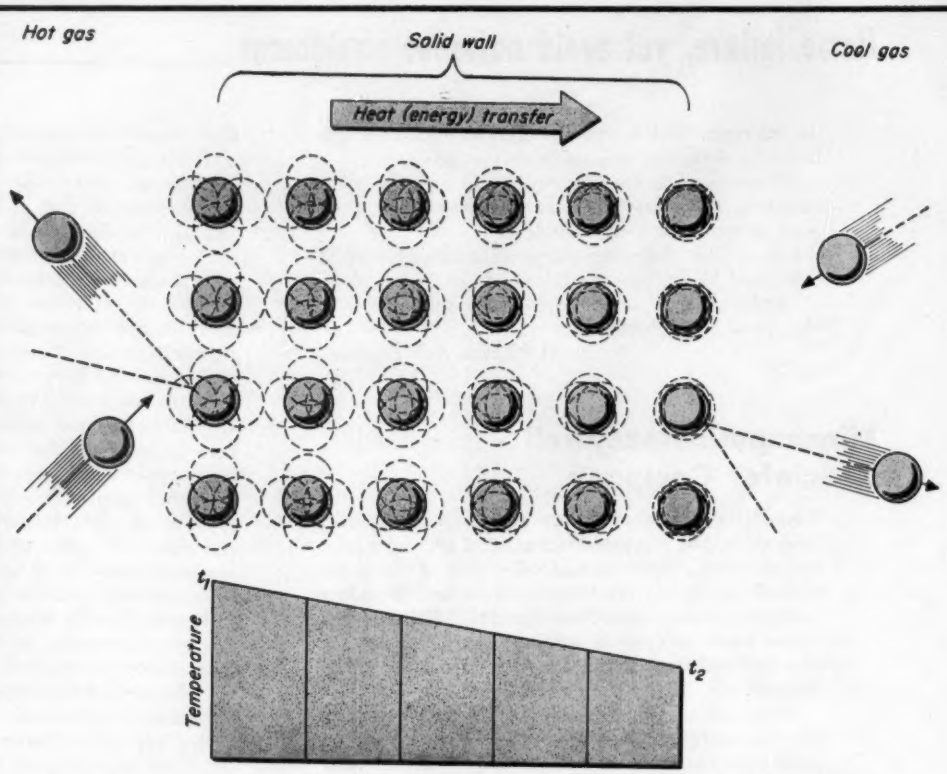
We have no evidence that response timings of small fractions of one second are advantageous on present fuel burners. We are also acutely aware of the difficulty in designing timing circuitry shorter than ½ second. The additional expense is sobering. Field demand and our own experience will guide us until future trends forecast change.

We can see no practical reason for incorporating variable response timing in our equipment. The operator would probably adjust toward the maximum provided, to avoid nuisance shutdown.

In our experience, proper use of modern flame failure safeguard equipment restricts development of conditions that have been found responsible for about 80% of combustion explosions.

G E LIND, *Manager, Field Engineering*





1 Kinetic energy of hot gas molecules, *left*, decreases as they slam into wall molecules. Wall molecules pass along energy as bigger vibration to neighbors, then on to cool-gas molecules

Last month we built up some ideas about the basic nature of energy and how it is related to mechanical work. Now let's dig into heat energy, pressure and simple gas laws so we will understand how both . . .

By B G A SKROTZKI, *Associate Editor*

Heat and pressure affect gas behavior

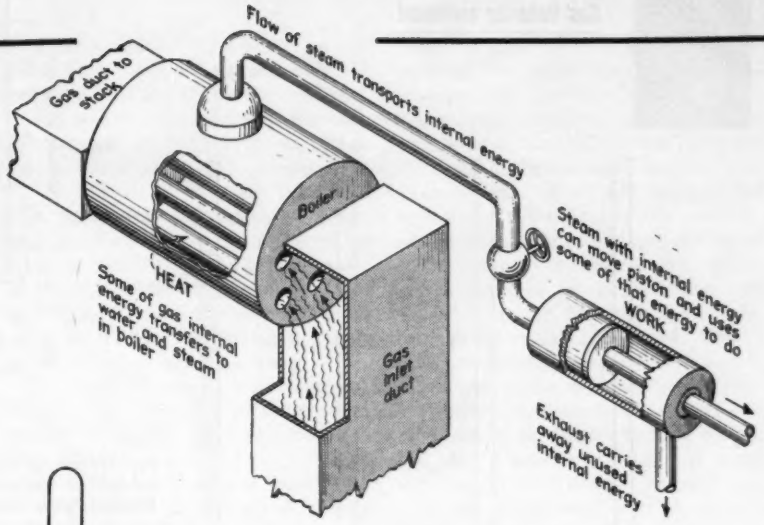
► IN PART 1 we learned about the potential and kinetic forms of mechanical energy and how they are paralleled in molecular form to be known as internal energy. Mechanical work we defined exactly and showed it to be a form of transferring energy from one body to another.

Heat. When we mention heat in everyday living, we all understand what is meant. Perhaps the most common example would be heating a room by a steam radiator. Ordinarily we say the steam in the radiator has heat. In thermo, we are more precise and say the steam has internal energy.

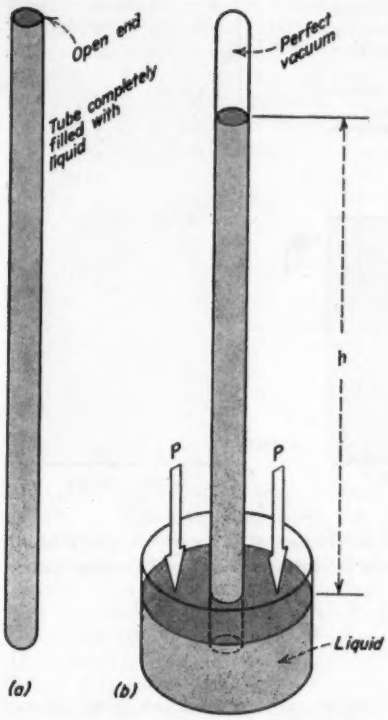
This may seem a rather fussy distinction, but there's a good reason for it. In thermo, *heat* means the *action of transferring internal energy* from one body to another. Then if we say the steam heats the air in the room, that's technically correct. The air's internal energy is being raised by the internal energy disappearing from the steam.

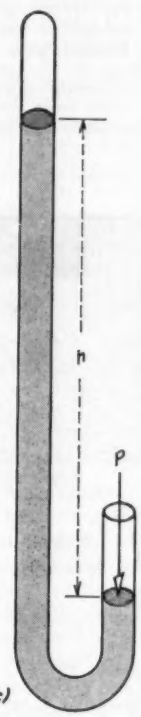
Heat transfer. Let's use our imaginary molecular picture to explain just how heat acts. Take an example of a closed tank divided in half by a thin wall. One half holds a hot gas and the other a relatively cool gas, Fig. 1. Hot-gas temperature equals t_1 and cold-gas equals t_2.

The hot-gas molecules with their internal energy rush around at great speed, colliding with each other, the walls of the tank and the dividing wall. Whenever a hot-gas molecule hits a wall molecule, the latter absorbs some of the kinetic energy by vibrating faster, or bouncing around in all di-

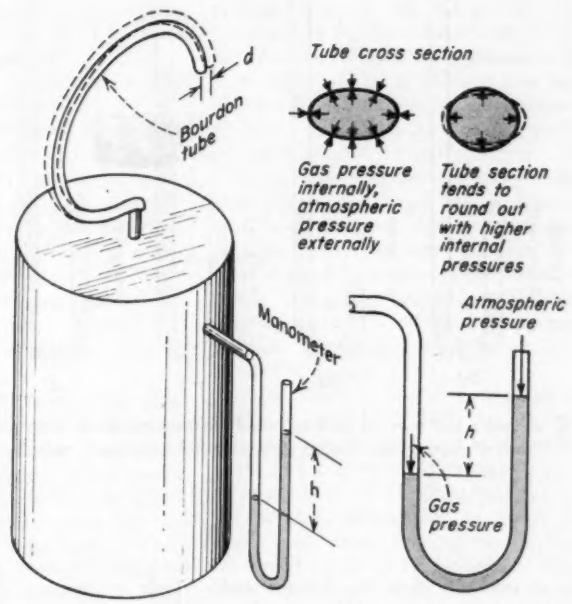

Flow of steam transports internal energy
Gas duct to stack
Boiler
HEAT
Some of gas internal energy transfers to water and steam in boiler
Gas inlet duct
Steam with internal energy can move piston and uses some of that energy to do WORK
Exhaust carries away unused internal energy

2 Part of gas internal energy flows to water and steam in drum by heat transfer. Steam flowing from drum enters cylinder and gives up part of its internal energy in doing mechanical work to push the piston to the right





3 Pressure *P* exerted by air molecules forces liquid up tube that has perfect vacuum at top; *h* measures air pressure



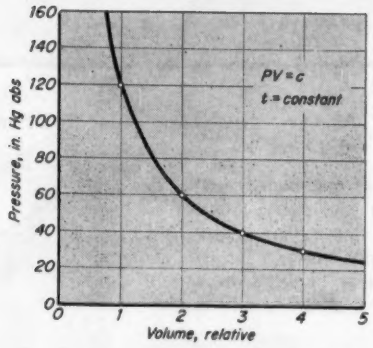
4 Pressures may be measured by deflection *d* of bourdon tube or by manometer differential *h*. Latter is for low pressure

rections. The gas molecule rebounds with reduced speed because it gave up some of its kinetic energy to the wall molecule.

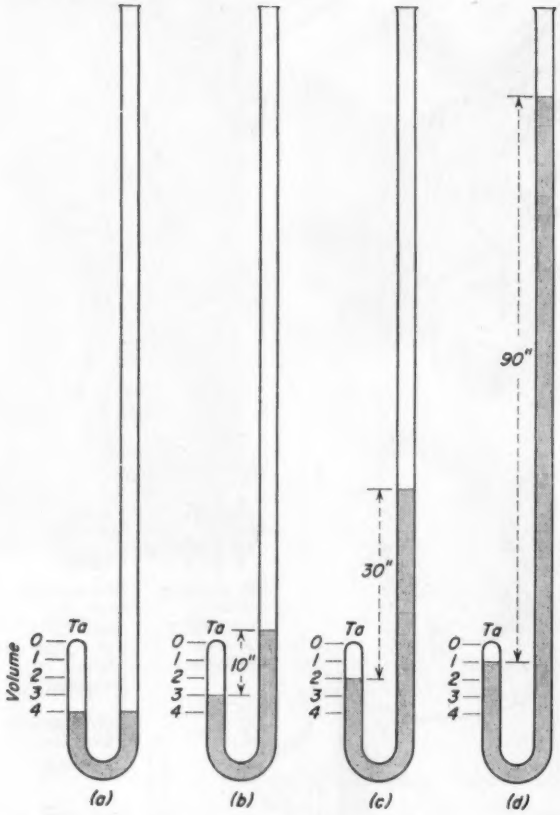
Increased movement or bouncing of the outer wall molecule makes it push and pull on its neighbors through the mutual attracting and repulsing forces they exert on each other. This makes the outer wall molecule do work on the other wall molecules and so give up some of its kinetic internal energy gain to the others. This action continues through the depth of the wall so that soon the outer wall molecule exposed to the cool gas begins to vibrate faster. In this way the wall molecules pass the internal energy along from the hot side to the cold side. Each, in turn, loses some as it shares what it gains with its cooler neighbors.

As the hot-gas molecules continue hitting the outer wall molecules, however, the supply of internal energy keeps coming to the wall. So we have a condition set up as shown in Fig. 1. The wall molecules successively have lower internal energy, which we measure as a drop in temperature through the wall from the hot side to the cool side. The rate of temperature drop through the wall depends on whether the material is a heat conductor or insulator.

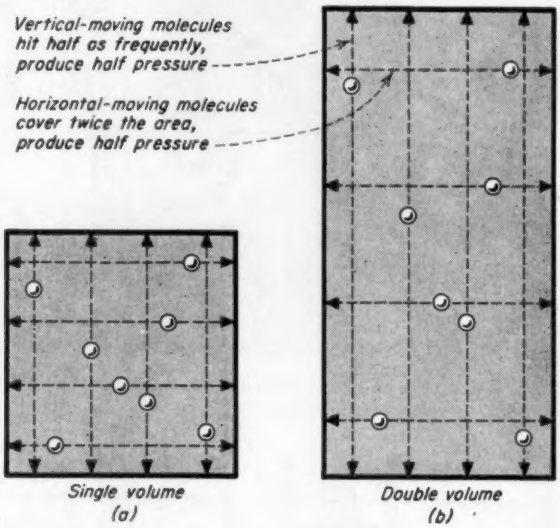
Now let's study what happens between the wall and the cold-gas molecules. The outer wall molecules on the cold-gas side begin vibrating faster as they pick up energy from the interior molecules. The cold-gas molecules are rushing around colliding with each other and the wall, but at



6 Pressure-volume relation of Boyle's law shows that the pressure drops while volume rises



5 Boyle's law may be demonstrated by trapping air in closed end of manometer and varying pressure, keeping T_a steady


Vertical-moving molecules hit half as frequently, produce half pressure
Horizontal-moving molecules cover twice the area, produce half pressure
Single volume
(a)
Double volume
(b)

7 Simplified molecular picture of gas explains why pressure falls when volume increases and temperature stays steady

a slower rate than the hot-gas molecules. Whenever a cold-gas molecule collides with a wall molecule, the wall molecule acts like a baseball bat and sends the gas molecule (baseball) rebounding with increased speed—that is, more kinetic energy. In this way, the wall molecule gives up some of its internal energy to the gas molecule.

So there's the continuous process, the hot-gas molecules give up internal energy to the wall molecules, which share it among themselves and pass most of it on to the cold-gas molecules. As we said, this is heating—the transferring of internal energy from one body to another.

Traveling energy. Let's get squared away on terms. Heat we now recognize as the transfer of internal energy; so heat might be called traveling energy. Work also falls into this class for mechanical energy; it is the transfer of potential or kinetic energy from one body to another. When this is clear to us, we realize that a substance or body doesn't contain heat or work in the sense that it has internal energy or mechanical energy.

In thermo, we consider work and heat as the main two methods of adding or subtracting energy from a system or body. You would rightly add heat and nuclear radiation, fission and fusion as other ways of transferring energy, but they need only be considered for special cases. Work concerns movement and position of a body in relation to a system of bodies. Heat deals with changes in internal condition of the body's molecular energy—that is, position and movement of its molecules.

Energy changes. Fig. 2 shows the basic processes in a simplified power plant. Here a waste-heat boiler passes waste gas through its firetubes. Some internal energy of the gas transfers as heat through the tube walls to the water and steam in the drum. Steam carrying internal energy flows in to the engine. Here the steam pushes out the piston. The steam exerting a force on the piston and moving it does mechanical work by giving up part of its internal energy. At the end of the piston stroke the steam leaves the cylinder, carrying along its remaining internal energy.

Let's review what happened here. The waste gas gives up some internal energy in the boiler. This energy passes as heat into the water and steam. This heat raises the internal energy of the water to boil it off to steam. Steam flows to the engine and gives up part of its internal energy to do work on the piston With its internal energy reduced by amount of work done, steam exhausts from the engine.

Notice that these were all *changes* in internal energy. Never do we run into a situation where a body or sub-

stance gives up *all* its energy. This boils down to always figuring heat and work from *differences* in energy, before and after.

Pressure. Because of their internal kinetic energy, gas and vapor molecules fly around in space. They "fill" any container that holds them. After they collide with each other and the walls of the container, they rebound, going off in new directions. In this way they exchange energy with each other and the wall molecules. For a perfectly insulated container, the total energy in the gas stays constant.

As the gas molecules hit the walls they exert forces that try to push the walls outward. There are billions of gas molecules in a cubic inch of gas, like air, and they collide billions of times a second with a very small area of the wall. All these individual impacts add up to what we sense as a steady pressure on the container walls. If we can measure the total force F exerted on a wall with an area A, we figure the pressure P as:

$$P = F/A$$

When F is in lb and A in sq ft, the pressure P is in lb per sq ft, psf.

First let us get acquainted with the meaning of atmospheric pressure—we're always going to be concerned with it in thermo. Fig. 3 shows the elements of a barometer. Taking a closed-end tube and completely filling it with a liquid, say mercury as in *a*, stop the open end with a finger. Then turning it with open end down, immerse it in a dish of mercury. When you remove your finger some of the mercury runs out of the tube into the dish and the level falls from the closed end of the tube, Fig. 3 *b*. But most of the mercury stays in the tube. The height h is about 30 inches.

This is one way of measuring our atmospheric pressure. Inside the tube above the mercury level there is a perfect vacuum. (Actually there is a slight amount of mercury vapor, but it exerts such a slight pressure that we can ignore it.) Air molecules collide with the surface of the mercury in the open dish, creating a force or pressure that pushes the liquid mercury into every unoccupied crevice and cavity. There's nothing in the upper end of the tube (no opposing pressure) so the mercury gets pushed up into the tube until the weight of the mercury column h balances the pressure of the air.

Now don't be misled. The size of the mercury surface exposed to atmospheric pressure P has no bearing on height h. We'll get the same height (reading) for a U-tube barometer as in Fig. 3*c*. Here we see more clearly that the weight of the mercury in column h is counter-balanced only by pressure P of the air on the open end.

The standard barometer or barometric pressure is 29.9213 in. Hg when the mercury is at a temperature of 32 F. We could use any liquid for our barometer—for instance, water. Our standard barometer in terms of water is 33.932 ft H_2O when the water is at 60 F. Note the great difference in height. This is easy to understand when we realize that mercury weighs 13.595 times as much as water.

But we were speaking of pressures in terms of psf and then switched to heights of liquid columns. How are they related?

First, we must know that water at 60 F weighs 62.37 lb per cu ft. Since a height of 33.93 ft of water counterbalances standard atmospheric pressure, a column with cross-sectional area of 1 sq ft and height of 33.93 ft exerts a pressure at its base of:

$33.93 \times 62.37 = 2116$ psf and so

atmospheric pressure = 2116 psf

While the psf unit must be used in many thermo relations, as we'll find later, it's customary to express pressures in terms of lb per sq in., psi. All we need to remember is that there are 144 sq in. in one sq ft. Then:

Atmospheric pressure

$= 2116/144 = 14.7$ psi

The more exact value is 14.696 psi, but 14.7 is close enough for most of our calculations.

Gage vs absolute. Most of our pressure gages compare the pressure of gas or vapor against the pressure of air in our atmosphere. When measured this way, the pressure is called *gage pressure* and the units are *psi gage* (psig) or *psf gage* (psfg). When a gas has the same pressure as atmospheric air its gage pressure is zero —that is, 0 psig or 0 psfg.

Molecules of our air, however, bounce around rapidly and produce a pressure, even though we say atmospheric pressure is 0 psig. Pressure can be truly zero only when there are no molecules to hit a wall. This is done only by removing all the molecules from a container and creating a perfect vacuum. By comparing our atmosphere with a perfect vacuum we find it has an average *absolute pressure* of 14.7 *psi absolute* (psia.).

To find the true or absolute pressure of a gas or vapor we must add 14.7 psi to the pressure as read by a gage:

$$\text{psia} = 14.7 + \text{psig}$$

$$\text{psfa} = 2116 + \text{psfg}$$

Pressure gages. We usually measure pressures with a bourdon tube or manometer, Fig. 4. The bourdon tube, which has a flattened cross section, is closed at one end. The other end connects to the region where we want to measure the pressure. The gas or vapor being measured acts on the inside tube surface and tries to force the tube into a circular cross section. The gas or vapor does this against the stresses in the tube and the pressure of the air trying to collapse the tube.

The change in cross-section shape makes the tube try to straighten out. This deflects the free end of the tube through the distance d, Fig. 4. Deflection d measures pressure difference between gas in the tank and air of the atmosphere. Ordinarily the end of the tube links to an indicating hand sweeping over a graduated dial, and pressure can be read directly in psig.

In the manometer, Fig. 4, atmospheric pressure acts on the surface of the liquid in the open leg and the gas pressure acts on the surface of the liquid in the leg connected to the tank. Gas pressures higher than atmospheric push the liquid so it stands higher by distance h in the open leg. Then sum of liquid weight (in h) and air pressure just balance the gas pressure.

If the gas pressure is lower than atmospheric, the liquid stands higher in the connected leg, so that h plus gas pressure just balances atmospheric. Here h shows how much below atmospheric the gas pressure is. For this case we regard h as a negative number and add it to atmospheric to get the absolute pressure.

If the liquid is water, the height h in Fig. 4 would be 27.71 in. for a pressure of 1 psi. If the liquid is mercury, we find that 2.036 in. Hg equals 1 psi, or inversely, 1 in. Hg = 0.4912 psi.

Example: Manometer connected to a gas tank shows the mercury in the connected leg to be 1.5 in. higher than in the open leg. If the barometer reads 30.25 in. Hg, what is the absolute gas pressure in in. Hg abs and in psia?

Solution: Absolute gas pressure in the tank (note 1.5 is a negative number)

$= 30.25 - 1.50 = 28.75$ in. Hg abs

In terms of psia, this

$= 28.75 \times 0.4912 = 14.10$ psia.

In solving this sort of problem remember that barometric pressure varies continuously. Then if the gas absolute pressure in the tank remains constant, the manometer reading h varies with the barometer reading.

Boyle's law. To understand thermo we must know how gases behave. We can test one of the fundamental laws by the simple apparatus in Fig. 5. We need a manometer with a short sealed end, and an open leg of long length. The sealed end that's graduated has

(*Continued on page* 194)

Nuclear notes

By B G A SKROTZKI, *Associate Editor*

Fast neutron breeder reactor power plant of Power Reactor Development Company has been granted a conditional construction permit by the AEC. The 100-mw plant will be built near Monroe, Michigan at a cost of $40.5 million, as a part of the AEC Power Demonstration Reactor Program. The 26-member company includes the Detroit Edison Co which will use the power generated. Plant will start late 1959 or sometime during 1960. AEC has allocated 3929 kilograms of contained U-235 for the 25-year license period. This is net, a total of 38,805 kg will be transferred from AEC to PRDC and a total of 34,876 kg in scrap and spent fuel will be returned to AEC by PRDC. The reactor will be liquid-metal cooled.

Boiling Reactor Experiment No. 3 (Borax-3) was shut down in April after running for six months at the National Reactor Testing Station, Arco, Idaho. The unit had run at design temperature and generated about 2000-kw electricity. A second core of oxide fuel elements will be used in continuing the experiment as Borax-4.

Waste disposal progress has been given a lift at Argonne National Laboratory. Spraying radioactive waste solutions of aluminum nitrate into a heated, air-fluidized bed of aluminum oxide evaporates the water and converts the aluminum nitrate into aluminum oxide. The nonvolatile radioactive materials remain in the oxide. The oxide has a much smaller volume than the original solution, and can be stored without worry about its corroding through a container.

Latest information on Nautilus operation—submarine has sailed over 50,000 miles on its original fuel charge during last year and a half. Ship has run submerged for over 20,000 miles during this period.

Electric power direct from fusion may be possible according to Dr A Bishop of AEC Research Division. In a deuteron-deuteron reaction more than two-thirds of the energy released appears as charged particles. These will not be able to escape from the electromagnetic field confining them. The resulting interaction may generate electric power directly. To maintain a D-D reaction the materials must be heated to and kept at about 400 million degrees. Only a minute amount of fuel would be in the reactor chamber at any one time.

Elaborate underwater laboratory at Hanford atomic plant will enable examining highly radioactive uranium metal. Water 11 to 17 ft deep absorbs the radiation and protects research personnel. From walkways atop the 200,000-gallon shielding reservoir the researchers remotely manipulate the irradiated uranium rods sheathed in aluminum. Novel underwater equipment cleans the metal, weighs it, photographs it, examines it by miscroscope, measures the radioactivity, dimensions and average uranium grain size. General Electric runs the Hanford plant.

Nuclear meetings in Philadelphia will be held March 11-15, 1957 at Convention Hall under sponsorship of Engineers Joint Council and 15 other engineering and scientific societies. This includes the Annual Atomic Exposition of the AIChE. The National Industrial Conference Board will hold its fifth conference on atomic energy on March 14-15, 1957 at the Benjamin Franklin Hotel and Convention Hall.

"Biological Effects of Atomic Radiation" has been issued by National Academy of Sciences, Washington, D.C. This contains committee reports on: genetics, pathology, meteorology, oceanography, agriculture and radioactive wastes.

Power's DATA SHEET

No. 291

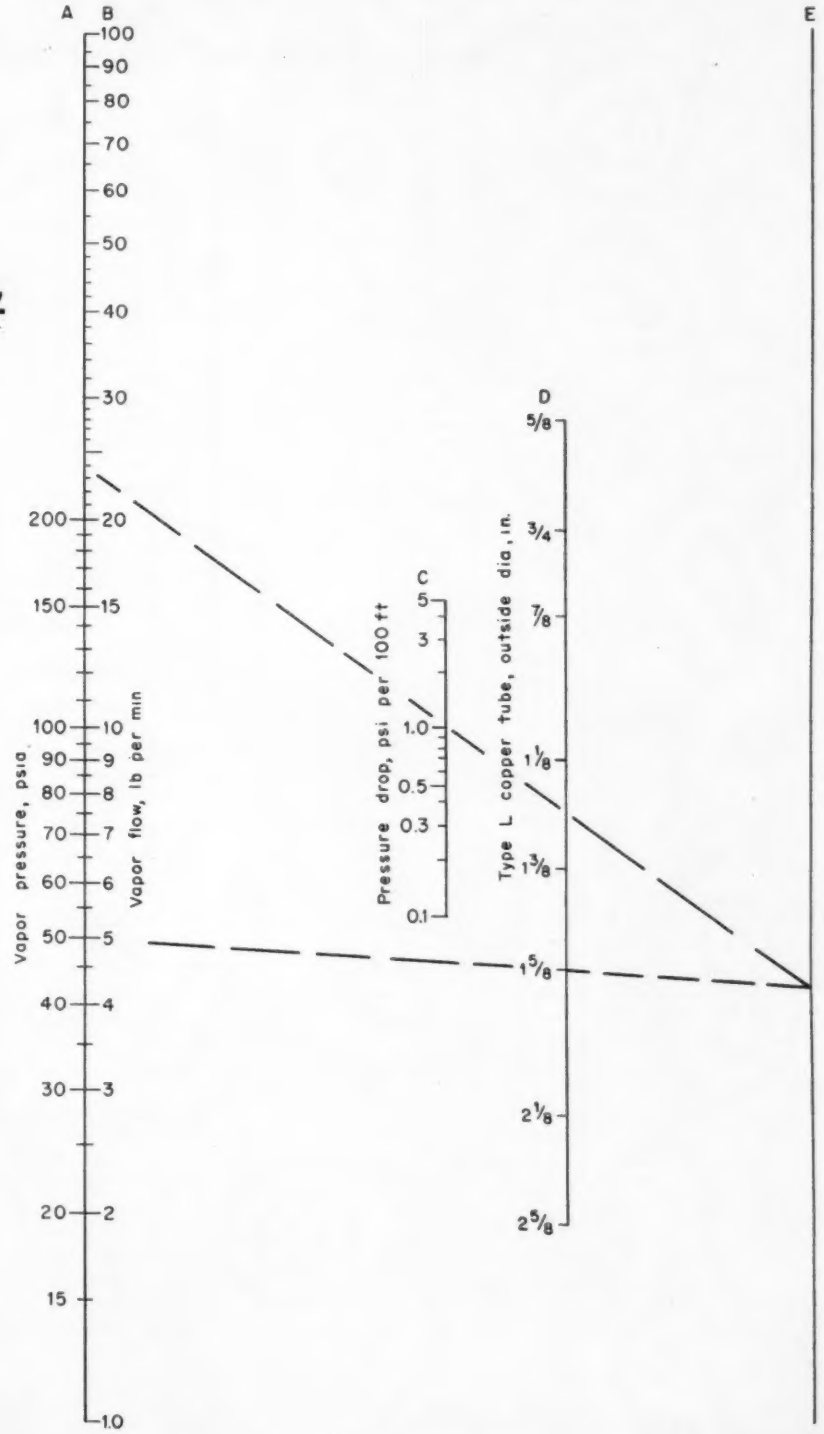
Freon-12 saturated vapor, pressure drop in Type L copper tubing

► When you pipe up refrigerating systems that use saturated Freon-12 flowing through Type L copper tubing, this chart will speed up the right size selection. All you need is (1) vapor pressure (2) vapor flow (3) allowable pressure drop per 100 ft. Example below shows how to use the chart:

Example: Freon-12 vapor at 50 psia flows through 1⅝-in. OD Type L copper tubing at rate of 24 lb per min. Find pressure drop per 100 ft.

Connect 50 psia on scale *A* with 1⅝ in. on scale *D*, using a straight line to intersect index scale *E*. Connect this point on *E* with straight line to 24 lb per min on scale *B*. At intersection with scale *C* read the answer—1 psi per 100 ft of tubing.

Glenn C Boyer
McPherson, Kansas



© POWER

why the Riley TURBO

. . . why it eliminates flyash disposal
. . . why practically any available fuel
. . . why higher operating economies

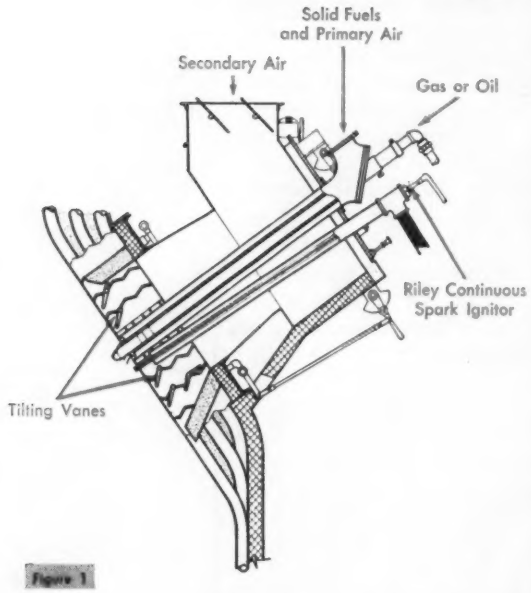


Figure 1

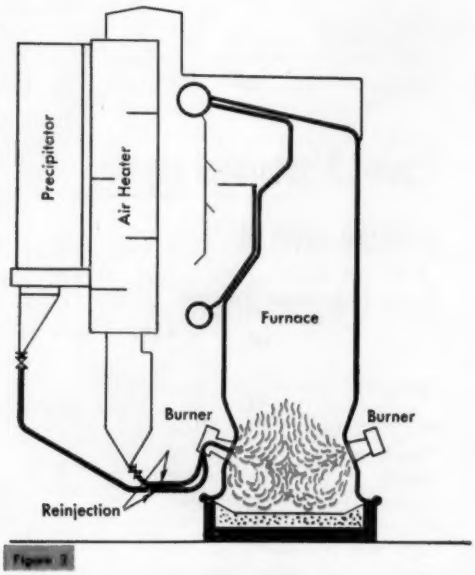


Figure 2

In 1952 a well known eastern chemical company had costly flyash disposal problems at two of its plants. At the time Riley Stoker Corporation had been developing a new type of slag tap furnace design to permit refiring flyash and disposing of it as slag. The idea was accepted. Two Riley boilers with the new furnace were installed . . . one to refire its own flyash, the other to refire its own and that of an adjacent conventional dry bottom unit.

The success of these boilers in eliminating the problem of flyash disposal is a matter of record . . . but the real success story lies in the other outstanding operating characteristics of this type of boiler unit, operating characteristics long sought by engineers and designers.

METHOD OF FIRING

Riley directional flame burners (Fig. 1) inclined slightly downward and located opposite each other in opposite furnace walls (Fig. 2) produce an extremely hot turbulent flame in a restricted, concentrated combustion zone just above the slag pool. Temperatures are high enough to maintain a fluid slag pool even at low loads.

MINIMUM CARBON LOSS

When flyash is refired in the combustion zone practically all the carbon in the ash is burned with residue turning to molten slag. Unburned losses are infinitesimal even in small boilers. Efficiencies of 90% and over are attained and sustained.

LOW FURNACE EXIT GAS TEMPERATURE

A "top secret" of the Riley *Turbo Furnace* is low furnace exit gas temperature produced by bottom-of-furnace firing. Temperature curves in Fig. 3 show *Turbo Furnace* exit gas temperatures at 100 F. to 220 F. below those of a conventional dry bottom unit operating at the same load, having the same capacity and the same amount of water cooling.

FURNACE EXIT TEMPERATURES THE SAME WITH ANY FUEL

The curves in Fig. 3 also indicate that in the *Turbo Furnace* the exit gas temperatures of a variety of fuels are approximately the same. For example, when burning natural gas the furnace bottom contour produces a luminous flame similar in size and appearance to coal flame; result: almost identical furnace exit temperatures.

USES A MULTIPLICITY OF FUELS

Because exit gas temperatures are so nearly identical with any fuel, the *Turbo Furnace* is uniquely suited for high steam temperature installations where uniform steam temperature is wanted while burning coal, lignite, gas, oil, fluid coke, or a combination of these fuels.

NO SOOT AND SLAG BLOWERS NEEDED

With retention of the major portion of ash in the furnace bottom and with resulting low temperatures in

An Advertisement Prepared By

Riley designs, manufactures and erects steam generating units complete with

Worcester New York Philadelphia Buffalo Pittsburgh Cleveland Detroit Chicago Cincinnati Charlotte New Orleans

FURNACE is so versatile

and does away with slag blowers
can be burned in it at any time
are attained and sustained

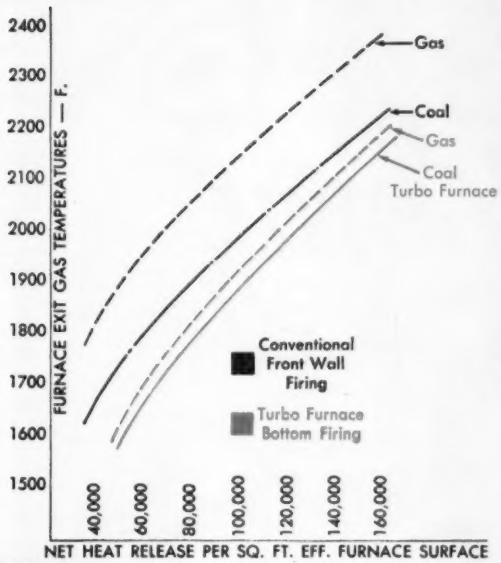


Figure 3

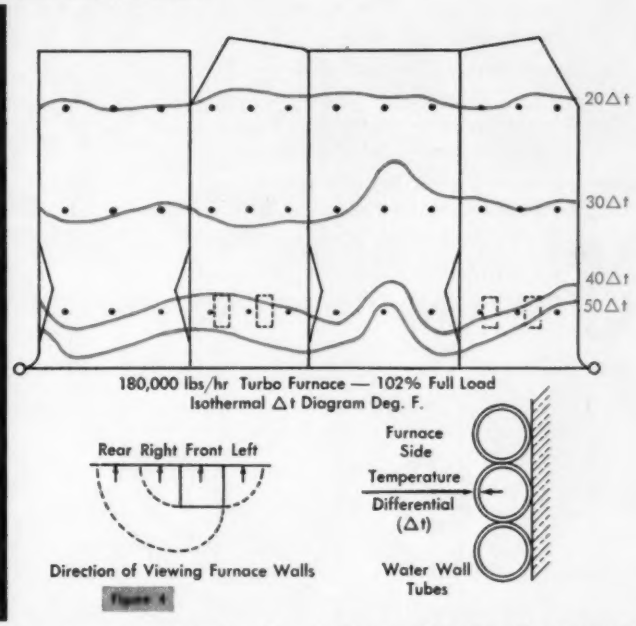


Figure 4

the upper part of the furnace no slagging occurs even with ash of lowest fusion temperatures. Since combustion is restricted to furnace bottom there is no impingement of flame on furnace wall tubes. Only a light dust coating on furnace walls and on convection tube bank occurs. (Fig. 4) illustrates the effect of the *Turbo Furnace* . . . relatively flat isothermal lines obtained in tests on one of the chemical company's units from readings of centerline thermocouples.

SIMPLIFIED DESIGN AND CONTROL OF SUPERHEATER AND REHEATER

With heat distributed evenly within the furnace and constant temperatures maintained regardless of fuels used the design and control of superheater and reheater for the *Turbo Furnace* unit is greatly simplified.

OPERATION POSSIBLE EVEN WHILE CHANGING TO SOLID FUEL

With pressure parts constant for all fuels a *Turbo Furnace* installed initially to fire gas or oil and designed with a furnace heat release compatible with coal firing can "stay on the line" during installation and hook up of solid fuel handling equipment. No ash hopper has to be added, and Riley directional flame burners are already equipped with coal heads for quick connection to pulverizers.

HIGHER HEAT RELEASES SMALLER SETTINGS

With lower exit gas temperatures the *Turbo Furnace* can be designed for higher heat release rates of both furnace envelope and furnace volume. A smaller furnace without a hopper bottom results in lower overall height.

ONE LEVEL BURNER OPERATION

Burner operation at or near the turbine level has long been desired. The Riley *Turbo Furnace* with all its burners on one level near the bottom of the unit makes one level operation a practical reality.

VERSATILE OPERATING FEATURES REFLECTED IN RECENT PURCHASES

An eastern seaboard public utility will operate three 500,000 lb. per hour *Turbo Furnace* units designed specifically to burn fluid coke plus oil, gas, coal. A Louisiana public utility has ordered a 1,550,000 lb. per hour reheat unit to fire natural gas, but for future conversion to solid fuels. Three 320,000 lb. per hour *Turbo Furnace* units will be installed by a prominent aluminum producer for gas, oil and future pulverized coal. A Texas public utility has purchased an 825,000 lb. per hour reheat unit for natural gas and future pulverized coal or lignite. Another Texas public utility has ordered a 1,260,000 lb. per hour reheat unit for gas firing and future pulverized lignite.

Such acceptance of a relatively new design is recognition of the sound operating advantages involved.

RILEY STOKER CORPORATION *of Worcester, Massachusetts*

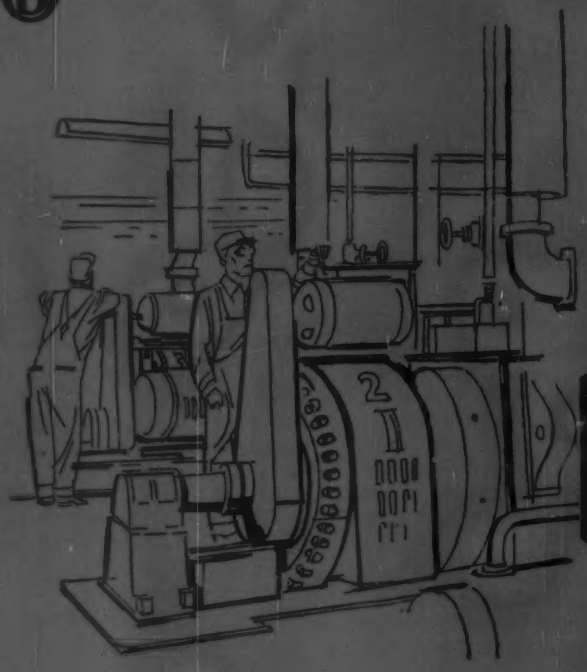
heat recovery equipment and fuel burning equipment for all industries and public utilities.

Atlanta St. Louis Kansas City St. Paul Houston Denver (Englewood) Salt Lake City Los Angeles San Francisco Portland Seattle

WHY BUY MORE VALVE THAN YOU NEED?

Some valve users apparently believe that quality bronze valves aren't available at ratings below 150-pounds steam pressure. Consequently, they buy heavier valves where 125-pound and even 100-pound valves would do the job, with complete safety. This is needless expense because Ohio Brass valves, with the quality features of higher pressure valves, are available at both 125-pounds and 100-pounds steam pressure. Ask your distributor about them.

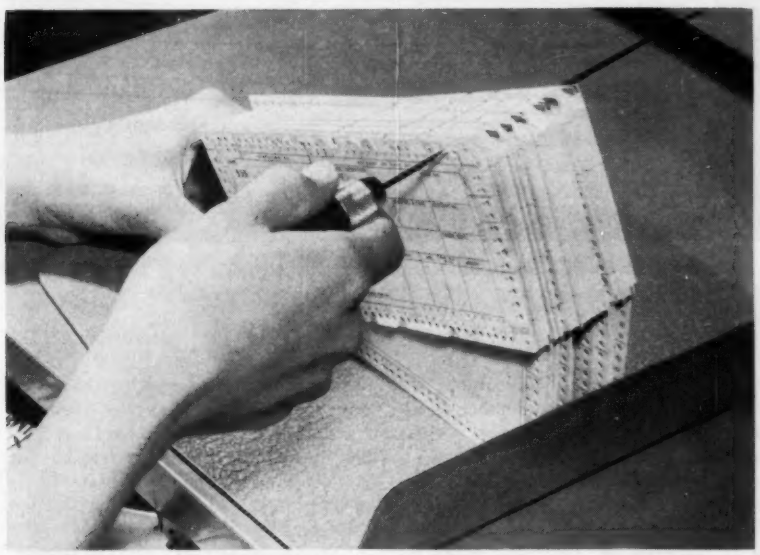
OHIO BRASS MANSFIELD OHIO, U. S. A.



O-B VALVES

STEVE ELONKA
Associate Editor in Charge

ELECTRIC GROOVER notches 200 cards at one time . . .



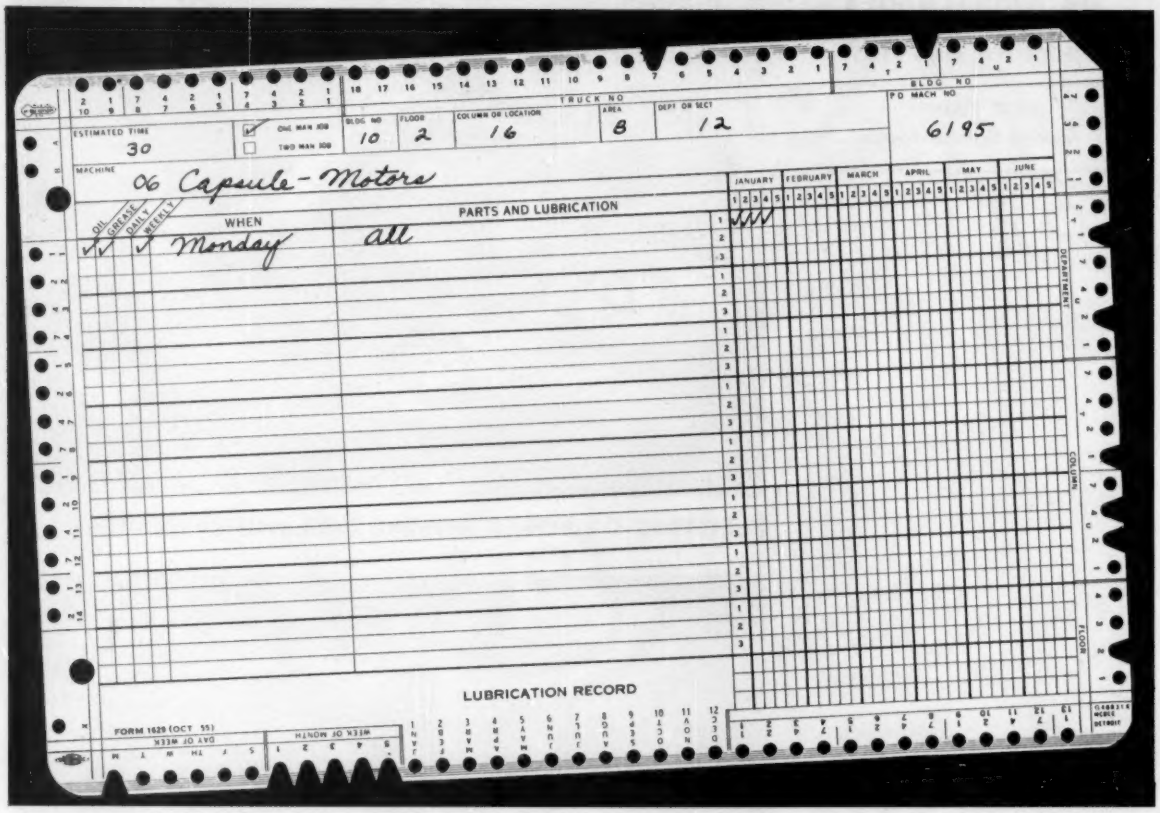
SORTING NEEDLE drops out next week's work for . . .

Sure-fire maintenance control

By R T MORGAN
Director, Technical Division
The McBee Company

► BASIC PROBLEM in scheduling maintenance control is not those jobs that come up regularly but the many that occur at irregular intervals. In the same way, you may brush your teeth every morning in a sleepy haze and never remember it, but when it comes to a haircut, the little wife must urge you to get it at the right time. Even so, if your plant is small, you may handle your problems OK with some extra attention. But what happens if you also have to plan for expansion? Usually it's not finance, buildings and equipment that stop you, but the strained capacity of management and supervisory personnel.

It's about here that accounting specialists like us come into the act. Many accounting and procedure problems thrown at us are tough. But as Air Force pilots say, scheduling main-



MARGINAL PUNCHED CARD controls the lube schedule of a plant with 40,000 motors scattered in 100 buildings

tenance control is a "milk run." We can stop breakdowns and other headaches and do this with only a little management supervision.

To prove our point, here's the case history of a firm who licked this problem with our key-sort cards. Let's meet B T Morgan Jr (author's note: no relative!), superintendent of Jackson Mills, No. 1, in Iva, South Carolina. His mill has used our cards for over two years.

"What has orderly scheduling done for you?" I asked my namesake. Morgan replied: "I don't know how we could operate without it, considering our expansion program. He then told how some of his men had voluntarily bought standard ledger books. By hand entries they tried to record and control the many maintenance jobs they had to do at times. "The human mind can't handle such a mass of details in that fashion," observed Morgan.

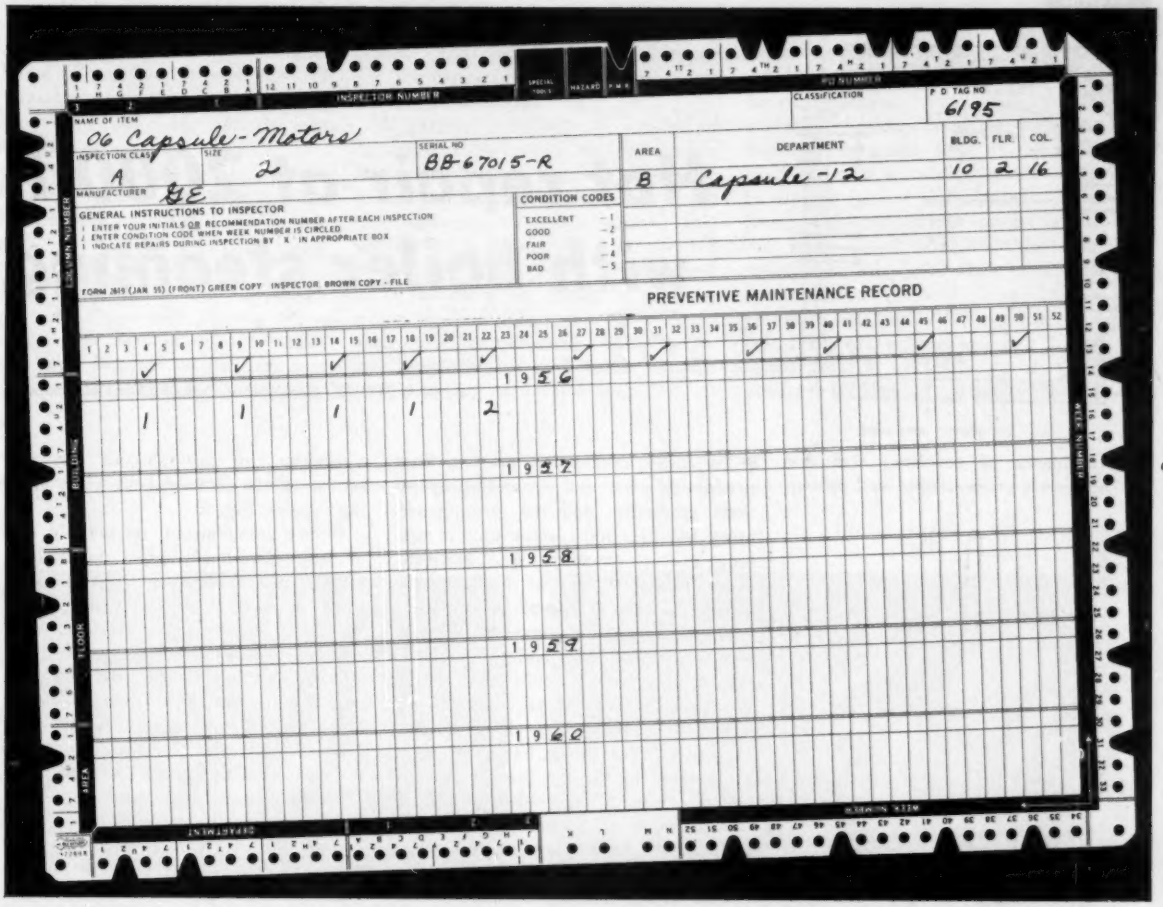
As an example, he mentioned the hundreds of motors in Jackson's No. 1 mill. We knew it would be impractical to oil all those motors on a regular 6-week schedule. Staggering the scheduling was the only answer. Morgan reported that Jackson's card-sort system turned up a high percentage of motors with bone-dry bearings—likely to burn out and cause a production stoppage.

"Equally important," Morgan told us, "was power loss from dragging motor bearings." Then he put his finger on an unexpected bonus from scheduled maintenance—doing away with breakdowns while increasing efficiencies. Old age moves with glacierlike but certain speed. Even the most alert management man can miss it. It's like a man who decides to get his eyes checked, when his trouble is really caused by a slowly dying reading lamp. Incidentally, Jackson Mills gets the maximum lighting it pays for in fluorescent overheads. Reason? Their key-sort system helps replace thousands of tubes on the hour that each has used up its efficiency.

I won't go into details about the various maintenance operations at this plant. That's because plant needs vary so much, even within industries. It's the presence or absence of regular frequency that counts. The several hundred motors of Jackson Mills makes an excellent example.

Common maintenance routine is to clean out motors with compressed air and vacuum. Because of lint problems a textile mill should make the cleaning of motors a weekly chore. But it's "painting the lily" to set up a punched-card reminder for a job done every Friday. That would be as useless as a string around your finger to get to church on Sunday.

But oiling motors is something else again. In many plants, excess oil thrown by a whirling motor is only annoying. So lubrication may be scheduled to assure it's done. In textile mills, however, a bit too much oil might ruin fabrics. Trick is just enough oil but not too much. That demands planning a nonperiodic schedule. But suppose your plant needn't worry too much about excess oil or some other detail —how do you remember to clean motors every three or four months?



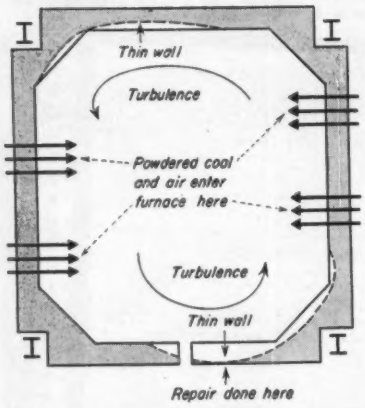
5-YEAR RECORD is in duplicate. Original is for inspection scheduling and duplicate for analysis of inspection reports

I assume most POWER readers know about punched-card procedures. Such cards make possible Jackson Mills' on-the-button maintenance control. My illustrations will help you. To oversimplify: Part of the card's coded edge may apply to (and usually does) the time when given jobs should be done. Let's suppose "Period 7" is the week beginning September 10. Every card with a labor operation for that week has the hole punched at the right spot. Operator inserts the sorting needle in all the cards, on the Friday before, and lifts them up. "Period 7" cards being unsupported, drop down—and there you have the maintenance work schedule for that week.

But there's more to maintenance scheduling than timing. Fred Stalcup, overseer of Jackson Mills' Group of Spinning Frames, has a complex maintenance problem that's duplicated by many plants. Each loom needs several maintenance operations. Various crafts are involved so each equipment must be assigned to the right mechanic.

(*Continued on page* 190)

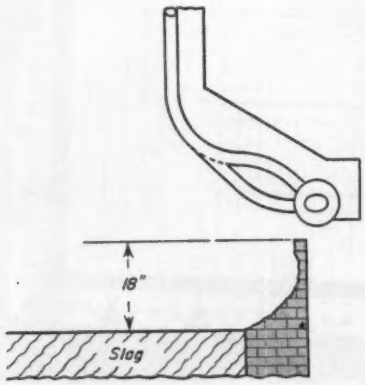
THIS CARD spots worn parts and gives you time to order if they are needed for stock. It also notes those parts that are to be installed on next inspection date



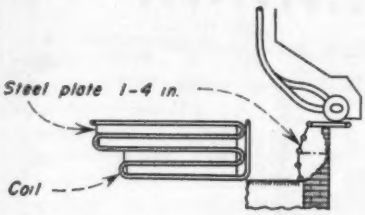
1 Turbulence of powdered coal and hot gas is cause of thin wall pattern

Hot repair at 2000 F with boiler steaming

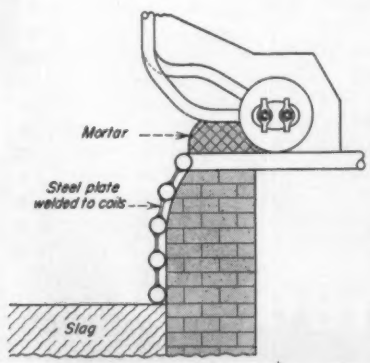
By W R STONE, *Carbide and Carbon Chemical Company*



2 Top of burned wall was red hot and so thin that it would not hold seal



3 Cooling coil with plate kept 2000-F heat away from wall during repair



4 Repaired wall has the cooling coil in place, backed up by new brickwork

► IN MANY INDUSTRIAL PLANTS, high production rates and expanding operations gradually load the steam-generating facilities until every unit is running at top capacity. The Institute, West Virginia plant of Carbide and Carbon Chemical Company, is no exception. Here, an all-time-record steam load has taxed our boilers until the loss of any capacity would mean a costly reduction in plant production.

Recently, one boiler developed an overheated area in the front refractory wall. That called for prompt maintenance service. It's a wet-bottom unit of the intermittent-tapping type, designed for 175,000 lb of steam per hour and operating at a 10% overload.

This boiler differs from the conventional slag-tap design in that the furnace bottom has refractory lining. The separately supported bottom has a dry-type expansion joint at the bottom waterwall header. Eighteen inches of the refractory wall lies above the minimum slag line and is exposed to direct flame attack. A section of this wall, 7-ft long, was in such bad shape that it had to be replaced at once, Fig. 1.

Powdered coal and air enter the boiler through burners as shown. Burners are about 10 ft above the floor. Indications are that the turbulence caused by this arrangement is partly responsible for the wall-damage pattern. But our problem was urgent. We had to repair the wall without a shutdown during a period of unusually heavy steam load. That called for some fast thinking on our part.

Part of the damaged area was behind a heavy-steel plate, which contains the slag-tapping door opening. It supports a hydraulically - operated - door mechanism. Only access to this part is through the door or through a 12-in.-wide space between the plate's top and the lower waterwall header. From the look of the brick at wall's top, we felt we could make a 2-in.-wide opening along the entire 7 ft without knocking the wall down, Fig. 2. Plan was to slide a cooling coil through this slot and screen off the furnace heat while making repairs, Fig. 3.

Before going ahead, we made a coil of 1-in. extra-heavy pipe and welded fittings. Spaces between the coils were filled in solid with ¼-in.-steel plate. We used continuous welds on both sides of each joint to transfer the most heat to the coil. Cooling-water supply and drain lines were installed, each fitted with 4 ft of flexible-metal hose. This allowed water to circulate through the coils as the unit was installed.

Boiler is so arranged that flame can be directed up or down to control the furnace-bottom temperature. We directed all flames downward for a 48-hr period to bring furnace bottom to maximum temperature. Molten slag was then tapped down to minimum level, and flames directed upward. We then changed the boiler over to hand control and set the furnace pressure to minus 3 in. of water.

With all these preparations complete, we carefully cut away the upper brick. That gave us a slot wide enough to insert the cooling coil. Coil was held against bottom of the waterwall header as we slid it in place. That prevented damaging the fragile wall. Then pipe connections were secured to the steel work, with the bottom edge of the coil resting on partly solidified slag. We removed a brick section at right of the steel plate and plugged open spaces around the cooling coil. We did this by pushing the old firebrick through the large opening at right end of coil until the pile almost closed the space. Bricks were then plastered so the opening was entirely closed.

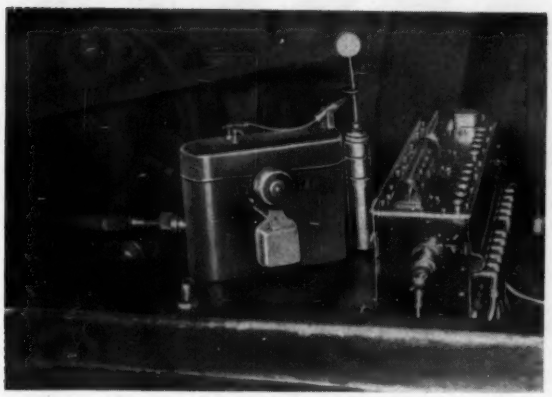
Large open space above the coil was screened off by setting loose firebrick on top of the coil, Fig. 4. Area of the exposed flame was thus reduced to about the size of the tapping door. Heat from this opening could be avoided or the doorway covered during most of the repair. Damaged brick was taken out, down to the minimum slag line

where the wall still retained its original thickness. Water flow through the coil was maintained at a high rate. Entire unit remained cool enough for the men to work in reasonable comfort.

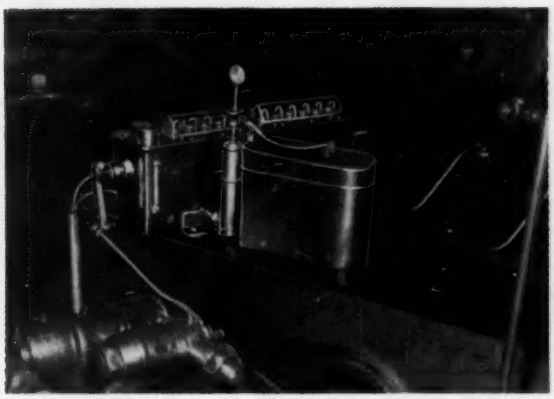
By working through the tapping door with asbestos gloves, one vertical row of brick on the opening's left side was built up level with the door's top. Brick at door's right was built to the same level and a 3x12x18-in. tile was worked across behind the steel plate to form a flat arch over the doorway. Then temporary brick perched on the coil was removed as the brick wall was completed. That left only a small space for the expansion joint packing under tubes and header.

A narrow, hard-to-get-to section of damaged wall behind the steel plate still remained to be repaired. We made a high-temperature ramming mix about the consistency of a thin mortar. This was shoved in through the 2-in. opening at the top of the plate. Mortar dried as it ran down the inside of furnace, piling up and filling out the wall to about original thickness. With the repair thus completed, all boiler controls were returned to normal operation.

Rate of heat removed by cooling coil decreased about 50% in first 24-hr of operation. That indicated the surface had been coated over with slag. But coil is being kept in operation until the next scheduled boiler outage to prevent further wall damage at this point. One interesting feature is that the boiler load remained the same throughout this job. Only noticeable difference was a small change in temperature distribution through the unit. But, all in all, we feel this is a unique repair job. It certainly cured a big headache by keeping our plant running.



ALARM has mercury switch, bell, white disk at tip of float



ANOTHER VIEW shows float reservoir connected to reservoir

Our homemade oil alarm now warns unskilled plant operators

► OUR 250-HP CORLISS ENGINE is too important to be knocked out by lube-oil failure. But with inexperienced operators you can't always be sure a machine receives proper attention. Our solution was to build a low-level alarm and attach it to our 12-place lubricator, as in the photos.

This type alarm is fairly easy to make from standard parts found in most engine rooms. And besides safeguarding a corliss engine, like ours, it will do a similar job on any type of power-plant equipment where it's needed.

Our alarm has an independent float chamber on the outside of a metal battery case. The float chamber is made of 1-in. brass tube. Tube's bottom end was sealed by soldering a brass disk. This float chamber is connected to the oil reservoir of the lubricator with a ¼-in. pipe nipple near its bottom end. This connection keeps oil in the float chamber at the same level as in the reservoir.

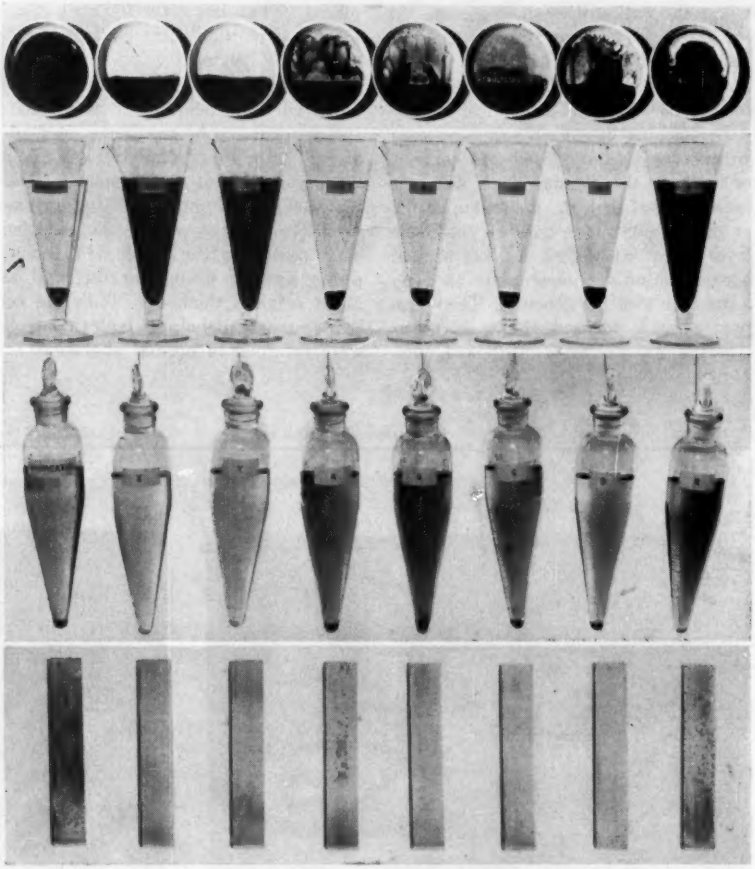
Float was made by inserting a 1/16-in. welding rod into a cork. To prevent the cork being saturated with oil and sinking to the bottom, we gave it several generous coats of shellac. Top of float chamber is a brass cap from a lamp socket. This acts as a guide and also keeps dirt out of the chamber. A metal disk is welded part way up on the welding rod to act as a trip for the mercury switch. This mercury switch is mounted on top of the metal battery case.

The outer end of the mercury tube has a U-shaped wire extension taped to its outside. This was necessary to make sure the tube would trip and yet not be damaged by the washer on the float rod. We also made sure our mercury tube would have enough tension at its hinge so hand setting would be necessary when it's tripped from low oil.

Metal case contains several 24-volt batteries. On the case's outside we mounted a bell. When the switch is tripped, this bell rings loud enough to be heard. To make sure that we know exact oil level in the lubricator at all times, we welded a metal disk to the top of the float. By painting this disk white so it can easily be seen from a distance, it is another safety measure.

This alarm has already paid for itself on several occasions in insurance to our engine. To make sure that it's in working order, we trip the mercury switch every now and then by hand. We have instructed our inexperienced men on watch to fill the lubricator immediately when the alarm goes off, and then call the watch engineer to investigate.

H NYE JOSELYN *Fort Dodge, Iowa*



SLUDGE PENETRATION, *top.* Note better solution flow in *X* and *Y*, compared to others. Additives *X*, *Y* and *E*, second photo, hold carbon-black particles over 48 hr. in No. 2 diesel oil. Accelerated aging, *third photo;* additives *X* and *Y* show no sludge in 48 hr at 210 F. Corrosion-inhibiting ability is shown by samples, *in bottom photo*

By **WILLIAM H CARLS, Jr**
The Perolin Company, Inc.

Pick the right additive to stretch your plant's fuel-oil dollar today

► USE THE PROPER ADDITIVE and you'll get more from your fuel and equipment. You'll cut oil consumption, reduce maintenance costs, and lower the rate of equipment depreciation. Refineries themselves are manufacturing and using additives for their furnace and diesel oils.

Why residuals? Increasing demand for gasoline and distillate oils dictates that refineries recover more of these products from basic crude oil. This downgrades the residual products so they now contain more of the troublesome components like sulfur, ash, water and sediment. Even distillate oil, produced by thermal and catalytic cracking processes and blended oils, tends toward instability. To use these oils effectively, you may need the help of an additive. The advisability of using one should be determined by actual operating difficulties and the question of the additive efficiency outweighing its cost.

To be effective, the additive should (1) inhibit, disperse and remove sludge formation (2) prevent corrosion in the fuel-oil-handling system (3) help prevent corrosion after combustion (4) emulsify or demulsify water (5) improve combustion and reduce deposit formation (6) present no safety hazards (7) be entirely compatible with the fuel.

Sludge formation and accumulation are the most noticeable contamination in a fuel-oil system. Sludge may come from precipitation of insoluble con-

stitutents of the oil or their emulsification with water. These insoluble constituents may be normal components or may be caused by deterioration as a result of chemical reactions like oxidation and polymerization.

Dispersing sludge components and preventing their agglomeration are an important function of a fuel-oil treatment. In breaking up and dispersing sludge, the additive also reclaims a material with a high Btu value. If manual sludge removal were required, the extra heat would be wasted and extra labor costs added.

For maximum sludge dispersal and removal, treatment should be added to the tank, on top of the sludge, before fresh oil goes into the tank. Subsequent loads of oil treated in the same manner gradually disperse the sludge throughout the fresh oil.

Severe sludge conditions require heavier dosages of additive. It is best to withdraw the tank contents to sludge level and add the heavy charge of additive on top of the sludge. Bad cases of sludge may make it necessary to use heating coils in the tank, agitation with compressed air, or recirculation of preheated oil from the burner to the storage tank (or from the main storage tank to an auxiliary tank in ships). The volume of fresh oil that goes into the tank after the additive, as well as the additive dosage, depends on the total sludge volume and its content of water and noncombustible sediment.

Light oils are not free from the sludge plague. Polymerization and oxidation form insoluble residues in light diesel and domestic oils. These relatively small amounts of sludge clog strainers and filters and plug fuel lines.

Corrosion. The presence of water is an important factor in corrosion of storage tanks and fuel-oil-handling parts. Residual fuel oil, as delivered, may already contain appreciable moisture. More water is continuously formed by condensation, leaking steam coils, water ballast in marine storage tanks, etc. This condition makes a corrosion inhibitor an important component of a fuel-oil treatment.

Many surface-active ingredients, used for other functions in an additive, may have the ability to inhibit corrosion. One corrosion inhibitor is an alkaline type that neutralizes acidity directly; also, it usually functions to promote film formation, which prevents contact of metal surfaces with water.

Corrosion after combustion. Sulfur, vanadium and alkali ash constituents in the fuel present the serious problem of corrosion after combustion. Corrosive effects are directly related to the production of sulfurous and sulfuric acids when the combustion products, sulfur dioxide and sulfur trioxide combine with moisture. Sulfuric acid production, which depends on temperature and dewpoint, governs the extent of corrosion.

In diesels, if the cylinder-wall temperature is maintained above the dewpoint so that sulfuric-acid production does not take place, there is little corrosion. But operation at light load at low temperature would accelerate sulfuric-acid formation. In a cold engine running on 3% sulfur fuel, more than half the apparent lubricant on the cylinder walls consists of sulfuric acid and metal sulfates, a costly combination for replacement parts.

Ash content of the fuel and relatively poor combustion conditions are also factors in diesel-engine corrosion and wear. Practically, it is impossible to isolate sulfur's corrosion effects from those of the other variables in the oil or differences in operating conditions.

USE IN BOILERS

In boiler operation, the picture is further complicated by the requirement of low-temperature flue gas for high boiler efficiencies; this is despite the resulting corrosion created by sulfuric-acid production.

When a fuel high in vanadium burns at a temperature high enough to melt the ash combustion products, the vanadium ash constitutent is deposited as a hard, dense slag residue, highly corrosive in nature. Also, vanadium, acting as a catalyst, promotes formation of sulfur trioxide from sulfur dioxide; result is corrosive sulfuric acid when sulfur trioxide contacts moisture. Any treatment to minimize harmful effects of vanadium should alter the characteristics of deposits formed. It should make them less corrosive and reduce the total amount of deposits produced.

In their work with steam-generating units, Babcock & Wilcox Company succeeded in getting a soft ash, more readily removable and less corrosive than hard slag deposits usually formed in superheater regions during combustion of fuels high in vanadium. Additives like aluminum oxide, calcium oxide and magnesium oxide gave these results. For effectiveness, these materials were mixed with oil in the ratio of 1 to 1000, based on an average ash in the fuel of 0.1%, or an amount of additive equivalent to the ash content. Their report also mentions advantages derived from lowering the dewpoint of combustion gas to reduce acid.

Similar favorable results in modifying gas-turbine deposits are also reported. In proper concentration, these additives raise the fusing temperature of the ash produced and prevent hard slaglike deposits. Treatments of the B&W type are used for this function only; they do not fall into the conventional category of complete fuel-oil treatments. They are first blended with oil in a concentrated slurry under constant agitation to prevent settling; the slurry is subsequently fed to the main oil stream.

A large gas-turbine manufacturer is testing an oil-soluble and oil-compatible form of additive at an electric power station. This additive retains the advantages of the mineral constituents mentioned above without their attendant operational complications.

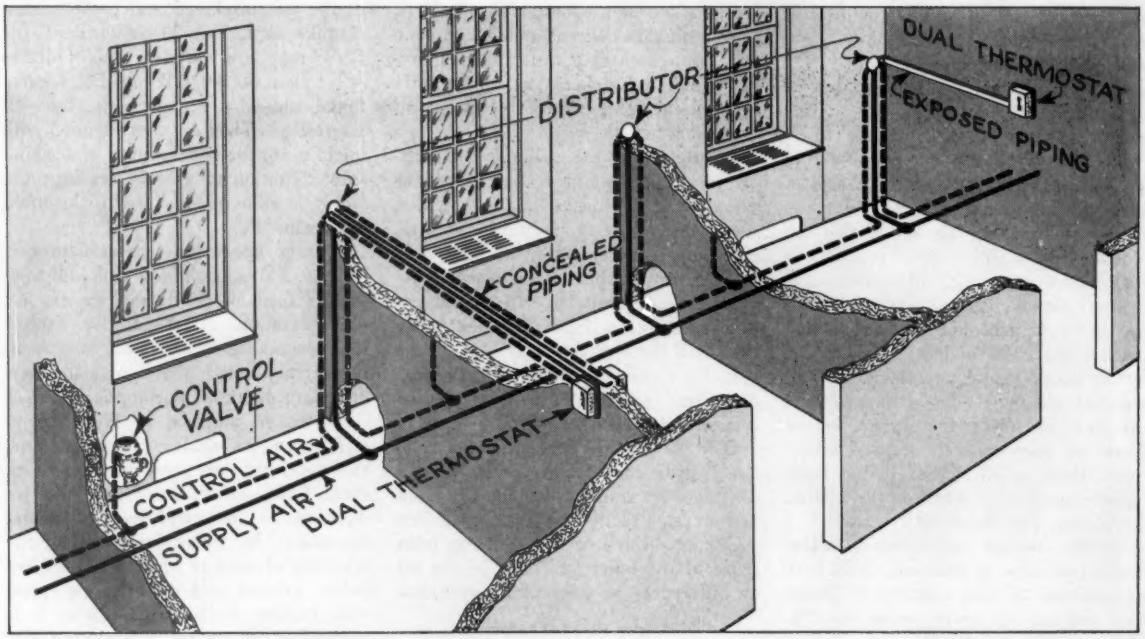
Water, in addition to being corrosive, promotes sludge formation and, therefore, requires removal. Use of an emulsifying or demulsifying additive depends on the conditions of actual operation. In industrial practice, the majority of storage tanks are installed below ground and are not equipped with bottom drain valves. Here, it is preferable to remove water gradually in an emulsified state.

The emulsifying additive reduces the surface tension between the two normally immiscible constituents to form oil-in-water and water-in-oil emulsions. It should also provide for uniform dispersion of small-size particles throughout the oil volume and promote uniform viscosity of the oil. Rate of emulsion requires control to limit the water content of fuel entering the burner. Special demulsifying additives break up natural oil-water emulsions. Application of heat helps the separation and settling of water. The place for a demulsifying additive is a tank where there is provision for withdrawing separated water from the bottom.

Demulsification is a more complex problem than might be presumed. In the petroleum industry it is common practice to consider each emulsion that must be broken an individual problem requiring special treatment. A minor change in one of the many variables, such as chemical characteristics of the oil, percentage of water, nature of mixing, heat, length of settling, may call for an entirely different additive. Because the specific gravity of bunker oils is close to that of water, there are sometimes no distinct layers of oil and water. Inorganic salts added to water may make the water phase heavier and create a specific-gravity differential.

In diesels it is normal to use a cleaning system with heavy fuels. Preheated oil goes into the system, which consists of two centrifuges in series

(*Continued on page* 198)



1 This pneumatic control-piping arrangement gives you good room-temperature control regardless of partition changes. Lines between the distributor in outside wall and thermostats relocate easily in the partition plaster or exposed molding

Know how to find the right spot for your room thermostats?

You don't just put them where they *look* best. They've got to sense changing weather conditions fast. If you're not getting the results that you've hoped for, increased control may well be the answer

By F C McINTOSH, *District Manager, Johnson Service Company*

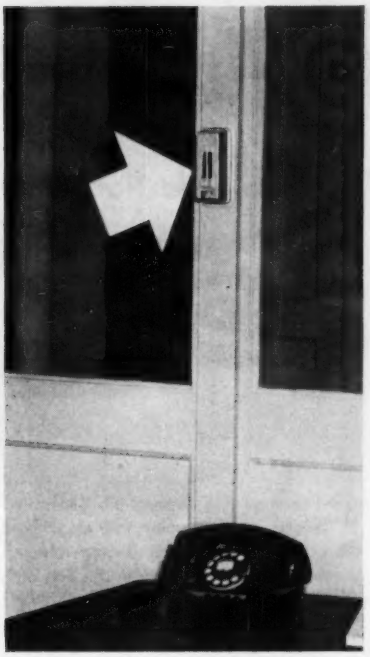
► INDIVIDUAL room temperature control was not uncommon as far back as 1894 in such buildings as schools and courthouses. And many steam heated office buildings had such controls as early as 1910. Office building control was successful in smaller towns, but generally not so in larger cities where tenant changes were fairly frequent and the new tenant was apt to want partitions changed.

Too often, temperature control lines were in partitions that had to be moved. Chief headaches were: (1) Mechanics who moved partitions weren't experienced in moving the lines. (2) Some of the changes left thermostats in poor locations.

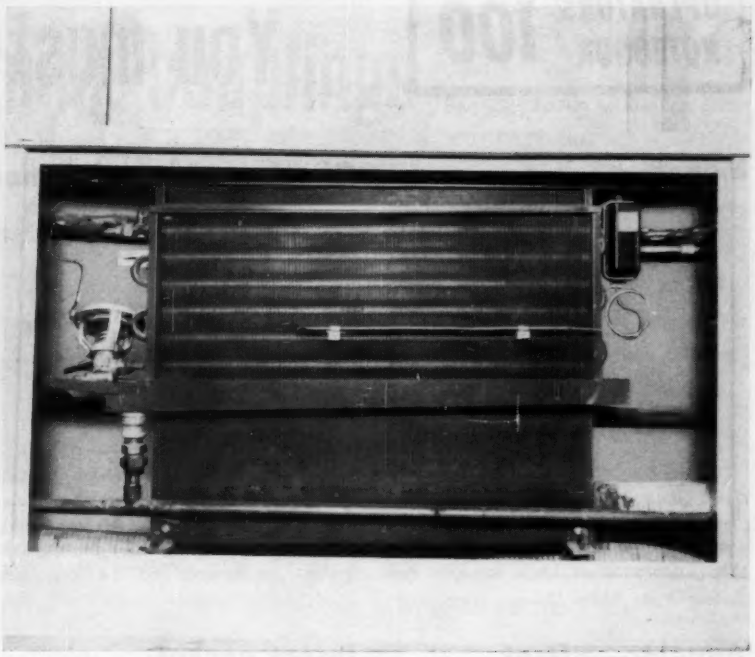
In 1930, design of specially arranged pneumatic piping simplified such changes. Fig. 1 shows how, from a junction in the outside wall, it became possible to put a thermostat at each side of the junction, letting two thermostats control separate sides, or one control both sides. Piping to controls on partitions could be put in the plaster, or in molding exposed on the partition.

But merely putting a thermostat in the space to be controlled isn't enough. Right spotting is most important to both comfort and cost. The thermostat should be where it senses changing conditions rapidly, especially where there is no mechanical air circulation. Location on a corridor wall becomes more objectionable as the distance from the outside wall increases. Ideal spot is a partition wall a few feet from the outside wall where sunlight, a chimney, or other heating or cooling source can't affect the control.

A thermostat in the right spot means quick reaction to weather changes—prompt response to room-temperature changes. Fast response provides closer control. Fig. 2 is an example of good location on a popular type of wall and



2 Good spot for space thermostat is on partition a few feet from outside wall



3 Heating-cooling unit installed at the outside wall. Thermostat, *at right*, controls the regulating valve, *left*. Partition changes don't affect control

4 Thermostat located on the wall opposite the unit ventilator has room air constantly moving toward it. Fast response of the control means lower operating cost

glass partition. Another arrangement with some heating-cooling units, Fig. 3, common in office installations, has the thermostat at the outside wall, so partition changes don't affect it. Although not called a room thermosat, its function is similar since it controls an individual space.

Choice of thermostat location isn't always easy either. With an office installation, a zone control may, for political reasons, be in the "inner sanctum." Thus good or bad zone operation depends on the whims of one man. For best overall results, control should be in the room having the most occupants. Sometimes an architect's artistry conflicts with his desire for good mechanical results. Many times artistry wins. Camouflaging the control is a concession to this point. But after all's said and done, the cost of good control can't be justified unless thermostats are put where they'll produce the best results.

Cost of control varies with the cost of arranging the system to be controlled. One thermostat does the job in a small building. But as horizontal dimensions of the structure increase, so does the need for more controls. As the system becomes more elaborate —as different sections need different temperatures—the job becomes too big for single thermostat control of the fundamental heating or cooling source.

Large buildings may need several controls for a single open space. A room with a long exposed wall and no forced-air circulation may be colder at one end. Or a room with a large dimension perpendicular to an exposed wall could need interior cooling while needing heating along the exterior wall. With systems where a relatively high air volume moves from outside wall to corridor wall, Fig. 4, a space thermostat opposite the heating-ventilating unit gives results because room air is kept moving toward it.

A building doesn't have to be very large before good control dictates at least one zone for each exposure, particularly where cooling is included. In winter, for example, with prevailing northwest winds, it may be possible to satisfactorily combine north with west zones and east with south. But in summer, it's better to combine east with north and west with south if only two zones are wanted. Cost naturally increases as progression goes through more zones to individual control.

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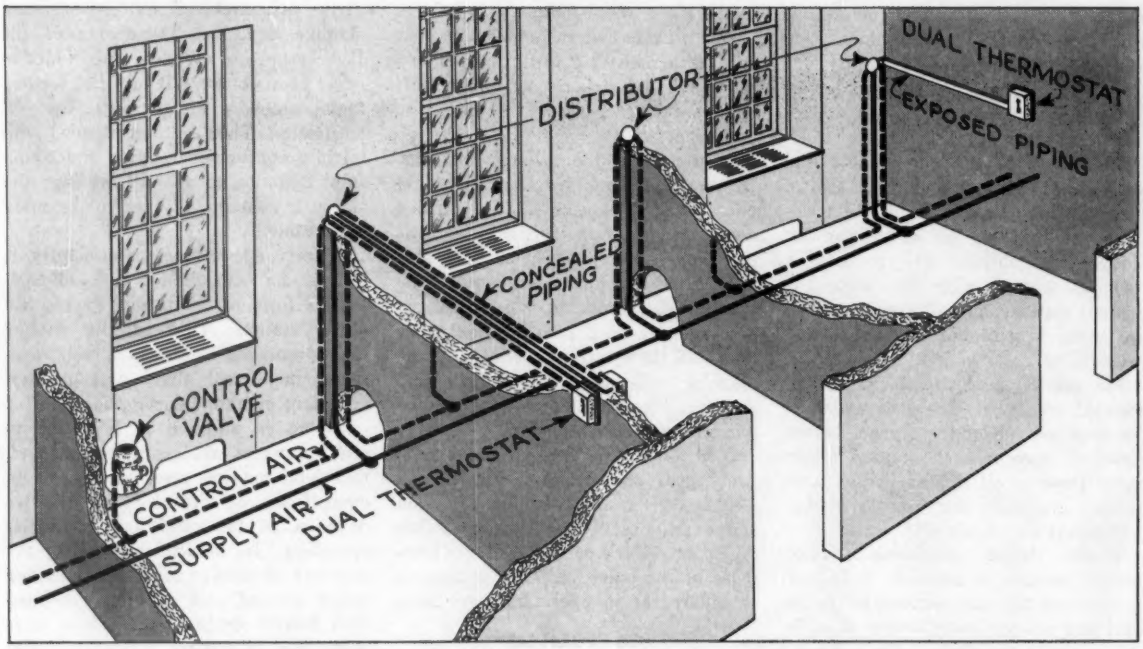

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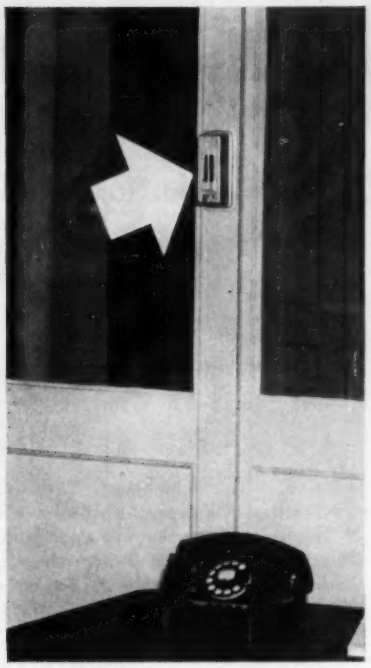

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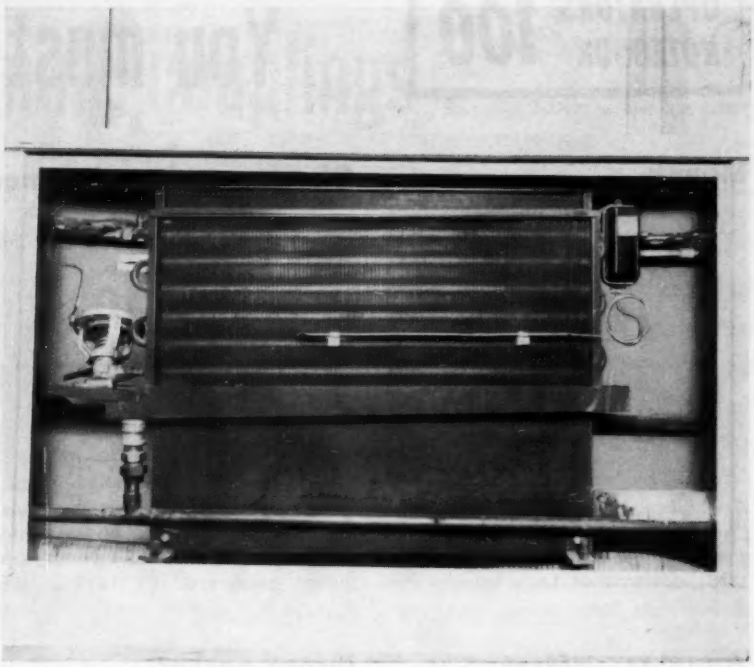

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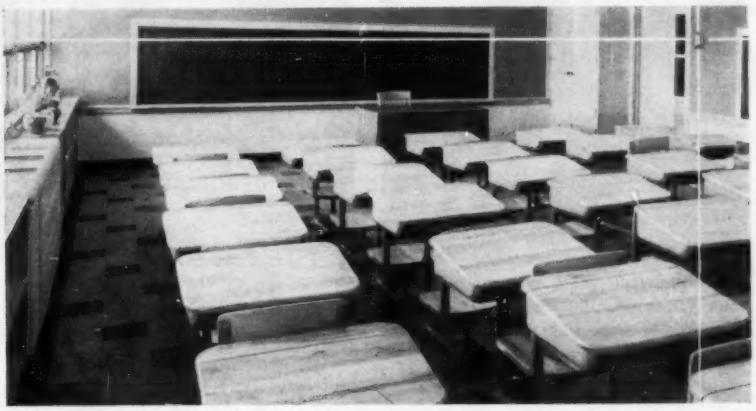

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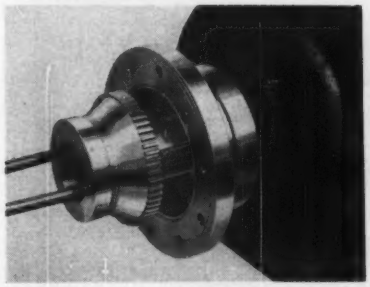
OPERATORS' NOTEBOOK 100

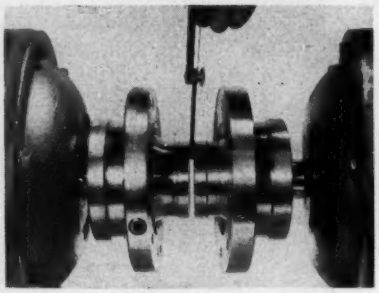
You must know how to

Mount...

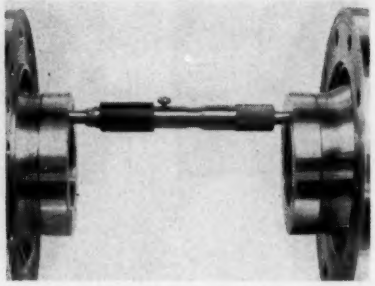


1 Expand sleeve hub with hot oil; slide on shaft with hub face flush with shaft end. Install key with tight fit on sides, clearance at key's top and hub

Check angular alignment...

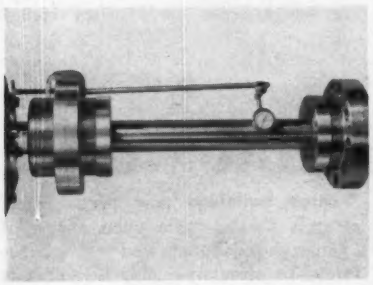


2 For normal hub separation, use feeler gage at four points, 90 deg apart. Position the machines with right hub separation as stamped on the hub body



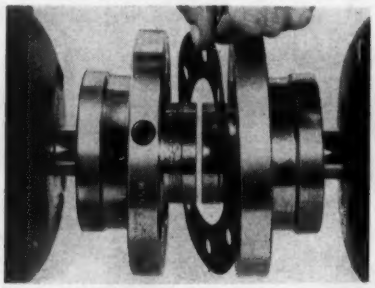
3 For wide hub separation, use micrometer at four points, 90 deg apart. This is same operation as second step. Again, see data stamped on the hub body

Angular—offset...

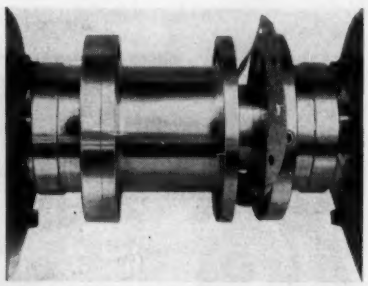


7 You can correct angular and offset misalignment on a floating shaft, as shown here, in one operation. Move either machine till readings are the same

Insert gasket...

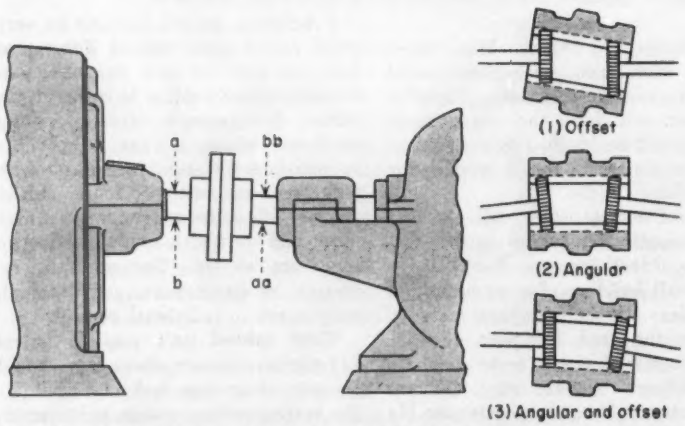


8 Check gasket or neoprene O ring to make sure there is no damage or tear. Clean coupling flanges well. Insert the gasket, or position O ring in groove

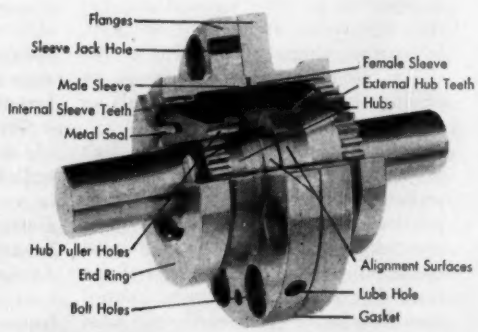


9 Position one gasket between each set of flanges for spacer and floating-shaft-type couplings. Follow same procedure for each gasket on this coupling

Here's why you must use right coupling



FLEXURAL STRESSES in a misaligned shaft go through a complete cycle of reversal at each revolution. Eventually they will do very great damage

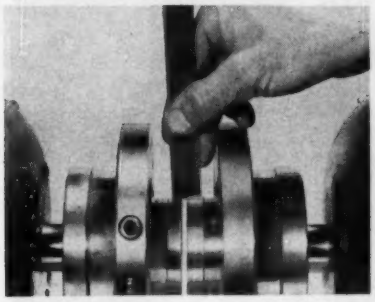


NOMENCLATURE and a peek inside will help you become familiar with this self-aligning coupling

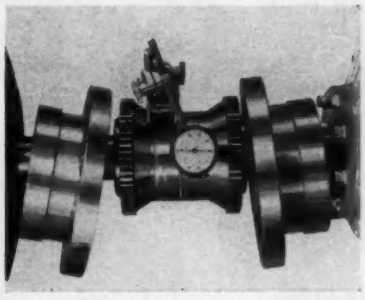
align self-aligning couplings

By STEVE ELONKA, *Associate Editor*

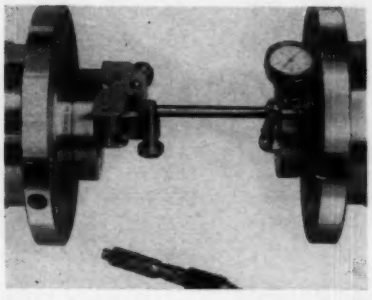
Check offset alignment...



4 Use straightedge (sight method) at four points, 90 deg apart. But always use precision alignment method, as shown in other photos if at all possible

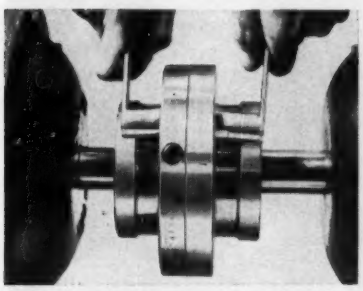


5 Fasten the indicator on one hub, with dial's button on other. Turn shaft and indicator. Take four readings as before. Move other machine in line, check



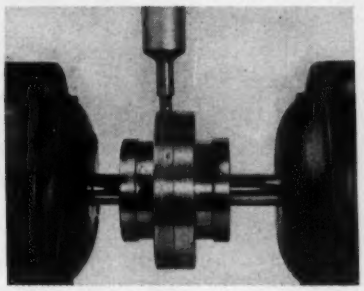
6 For wide hub separation, use dial indicator as shown here. It's important to check from both hubs and at four equal parts around circle, as explained

Assemble...



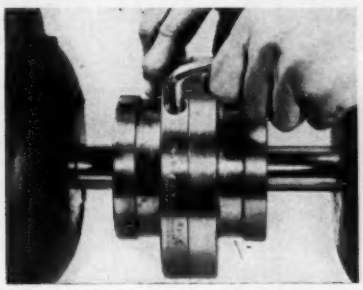
10 Draw flanges together. Keep bolt holes in line. Insert body-fitting bolts. Tighten bolts, nuts with wrenches no larger than furnished with coupling

Lubricate...



11 Apply lubricant recommended by the manufacturer, whether grease or oil. For oil, position holes 45 degrees from vertical, insuring the correct amount

Tighten plug



12 Before you replace lube plugs, check copper ring gaskets for their position and condition. Tighten the plugs with wrench furnished with the coupling

► SELF-ALIGNING COUPLING must protect both shaft and bearing from misalignment damage. Coupling should (1) be a permanent part of the transmission machinery (2) last as long as the connected machines. Double-engagement type compensates for misalignment without setting up whip or crank action. This avoids setting up harmful stresses in the shafts and bearings. The coupling is also built so all flexibility is mechanical—without flexible parts of any kind. This prevents fatigue and resulting failure in parts that are subject to repeated bending, tension or compression.

According to Prof H F Moore, U of Illinois, "Shaft supported in several bearings that aren't perfectly aligned is subjected to reversed flexural stress, shown at left. When shaft is in position shown, tensile stresses are set up at *a* and *aa*, and compressive stresses at *b* and *bb*. After half a revolution, metal that was at *a* in tension is at *b* in compression. So for each revolution there's a complete cycle of reversed bending stress. Such a shaft is subjected to millions of cycles of reversed bending in a few days' time."

This reversed stress condition is common as bearing alignment is rarely perfect when machines are installed. Worse, it rarely stays perfect. Misalignment overloads bearings as well as the shaft, causing hot bearings that often fail in time."

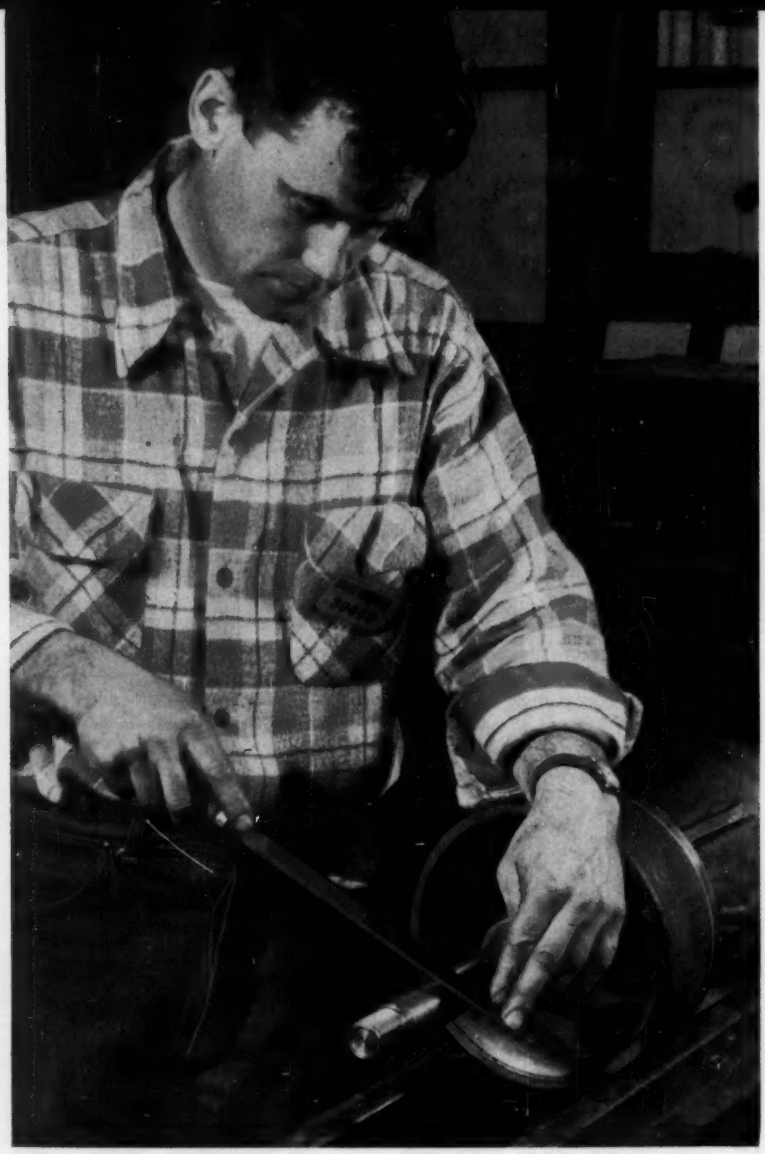
This coupling has a splined hub fitted to each shaft end. Sleeve, cut with internal splines, engages the hub's splines. As one shaft rotates, it drives the other shaft and entire assembly as a single unit.

Three forms of misalignment are: (1) offset misalignment—shafts parallel but out of line (2) angular misalignment—shafts in line but not parallel (3) angular and offset misalignment—shafts neither in line nor parallel.

In coupling shown, floating sleeve takes a neutral position. So misalignment is compensated for between the spline faces, equally divided between driving and driven members. Besides, this action gives you lateral float for shafts as the hubs can move closer together or farther apart without affecting idea of compensation for misalignment. This action is especially needed in herringbone gear drives, etc.

Now that we know something about this coupling, let's learn how to install it properly. For more complete information on aligning machinery, read *Plant Operators' Manual*, pp 114, 128, 129, McGraw-Hill Book Co.

Photos and text in this article, courtesy of Koppers Company, Inc, Fast's Coupling Dept, Baltimore, Md.



16 steps in overhauling deepwell turbine-pump bowls

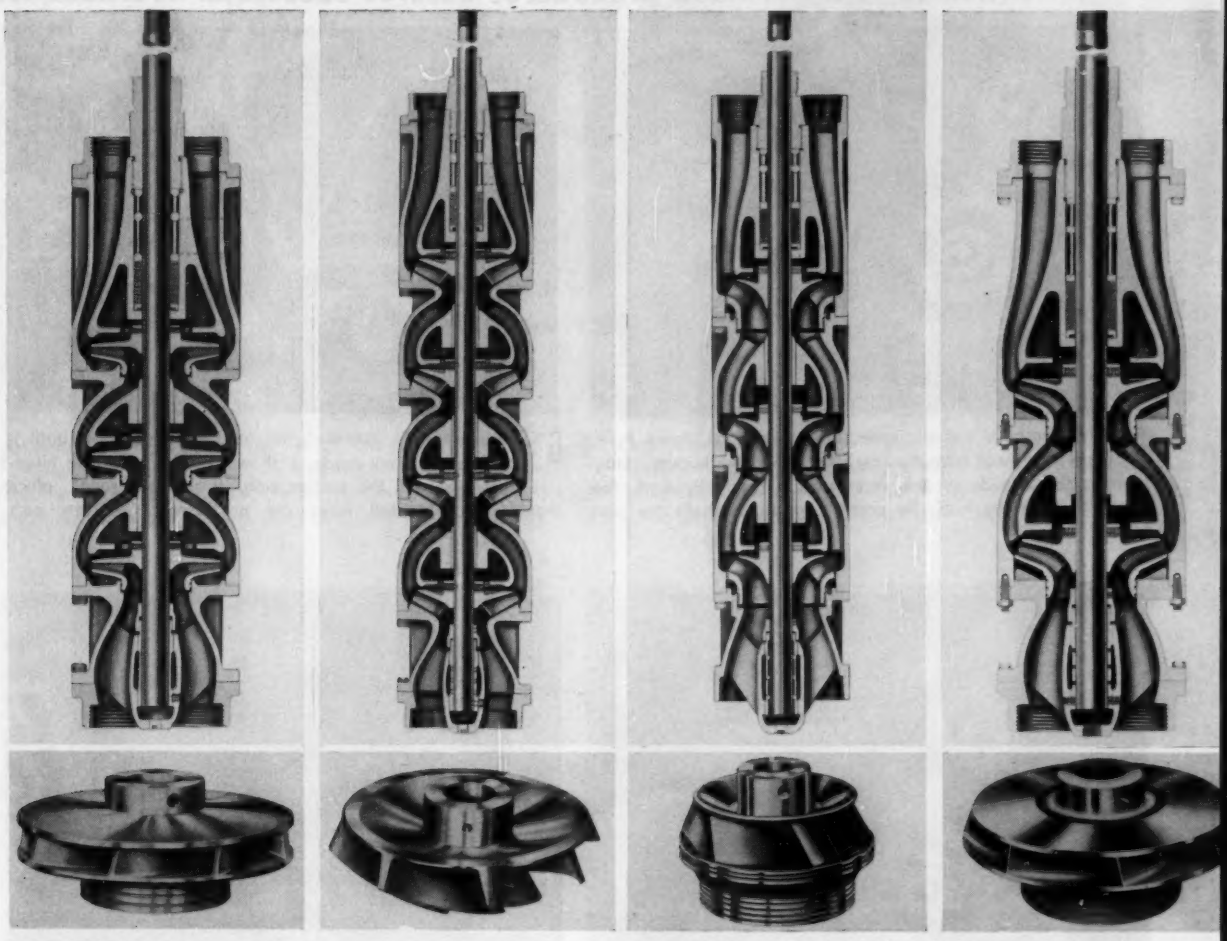
By **WILSON L DORNAUS,** *Senior Engineer, Pump Products*
Byron Jackson Division, Borg-Warner Corporation

► ASSEMBLY AND DISASSEMBLY procedures, illustrated in 16 steps on these four pages, apply only to bronze impellers. When stainless-steel impellers are used in a pump, it is recommended that the pump manufacturer do the overhaul work. Heat affects stainless steel differently so extra precautions must be taken when working with it. Also, there

1 Unbolt and remove the top case. Continue to clean shaft as the work progresses. Remove setscrews with screwdriver

2 Put metal sleeve or pipe over shaft against impeller hub. Heat from outside of impeller of hub. Pry impeller loose

For better service from deepwell pumps, use these overhaul procedures



FOUR DESIGNS of deepwell turbine pumps. First is for large-diameter wells with relatively high heads. Second is for average conditions. Third handles large capacities in restricted-diameter wells. The last pump has a closed impeller

is danger of galling or scratching the impeller bore when removing or installing it.

Dismantling. Start by removing burrs and scale from the pump shaft. Use a suitable file, top (left) on opposite page, to clean the shaft. Do not remove the casing or impellers until shaft is clean. This prevents damage.

Steps given here apply to any of the four pump designs shown at the top of this page, if they are fitted with bronze impellers. Remember, the impeller vanes are easily damaged, so use care in handling them.

Assembly. After overhaul, when assembling the pump, place the first impeller at a suitable distance from the shaft end, dimension *A*, Fig. 7, p 117. This dimension must be obtained from the manufacturer for the particular pump you are using. Check with builder on type of setscrew to use.

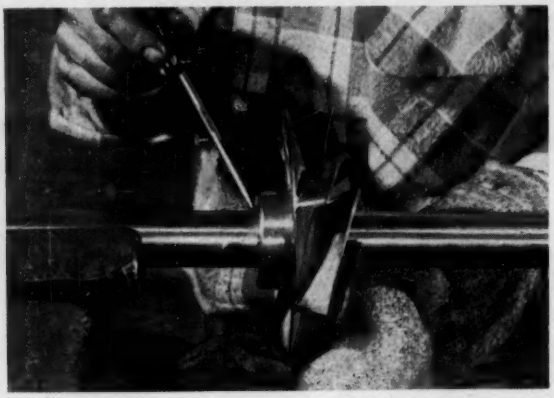
If you have any doubts about correct overhaul procedures for the deepwell turbine-pump bowls in your plant, check with pump builder. *Turn page*

3 Protect your hands with asbestos gloves when removing the hot impeller. Be careful not to damage impeller with tools

4 When ready to reassemble the pump, place first impeller in gas heater as shown and heat it for about one minute

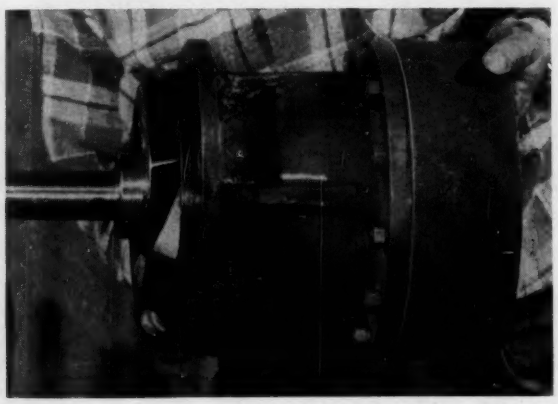
Attention to recommended procedures assures successful overhaul of

5 If a heater is not available, use a torch as shown here. Apply the heat from the torch for about one minute. Start heating the outside of the impeller and gradually work the flame towards the hub. Be careful not to overheat the part



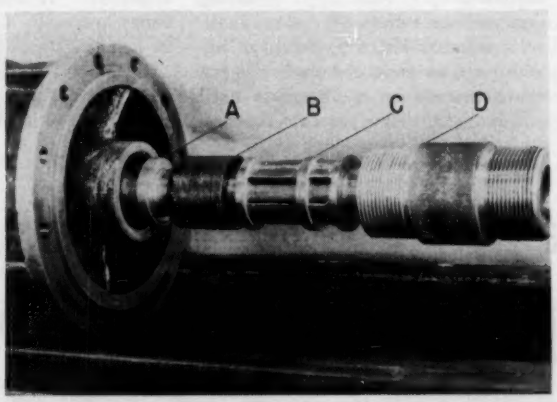
6 Place on shaft, hub-end first, and move up shaft until it reaches the mark made as shown in Fig. 7. Locate large-size impellers from the suction side. If this is a repair, place impeller so old drill holes are not used. Cool the part

9 Hand-fit the sand cap on the shaft and place it halfway between the end of the shaft and the impeller. Do not tighten the setscrew yet. The bottom case of the pump will be used to push the sand cap on the shaft until cap is in place



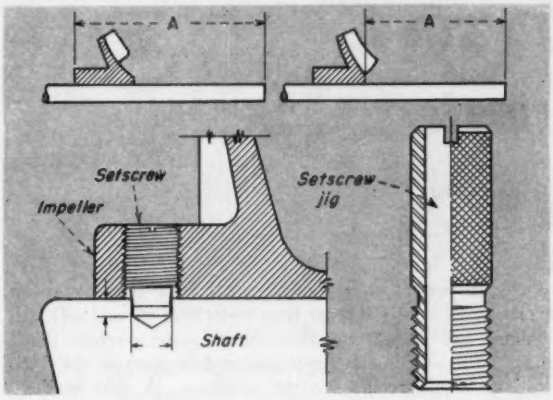
10 Using the bottom case to push sand cap farther on shaft, push case until it hits the impeller. Remove case, move cap ⅛ in. farther toward impeller for clearance. Use a ⅛-in. hollow-head setscrew to lock sand cap in place on shaft

13 After checking with feeler so that clearance is 0.002 in., Fig. 12, drill holes in shaft and insert setscrews, as was done for first impeller. Remove bottom-case capscrew, test unit for rotation and end float (or lateral). Replace

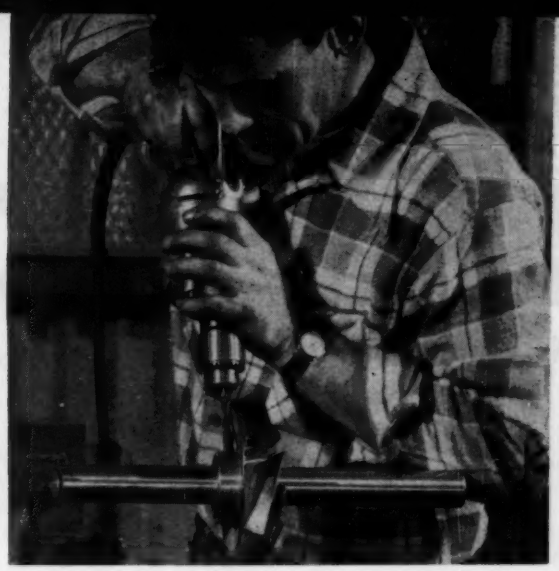


14 Continue this procedure until required number of stages are installed. Replace capscrew before installing next impeller. Bolt top case in position. Install stuffing-box ring *A*, packing *B* (usually 5 rings), cage ring *C*, bearing *D*

deepwell turbine-pump bowls



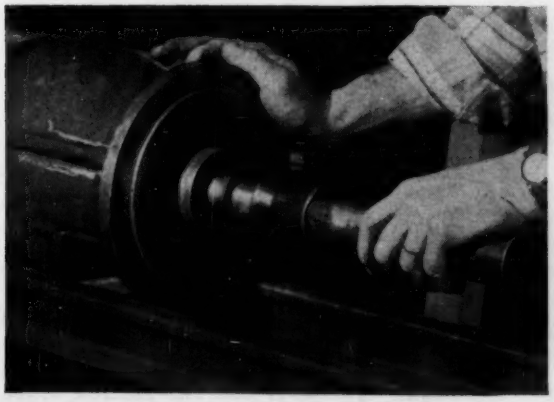
7 Before sliding the hot impeller on the shaft, place shaft in a vise, or support it rigidly by some other method. Then, from pump instruction book, determine the setting distance *A* for the first impeller. Mark distance on shaft with file or tool



8 Cool impeller in air until temperature is below 212 F. Then finish cooling by pouring water over it. When cold, drill setscrew holes in shaft for both sides of impeller. A drill guide should be used. Get drill size, depth from builder

11 Place the shaft and impeller on an assembly rack and push the bottom case back on the shaft. Move it against the impeller and lock it in this position with a capscrew, as shown here. Do all this work carefully to prevent trouble

12 Place first series case on shaft, starting at top. Move it down until it is flush with top flange of bottom case. Bolt both cases together. Heat next impeller and place it on shaft, suction side toward case. Cool, tap it in position



15 Install oil-tube sealing parts separately. Make sure each part is put firmly against preceding one. Use a sleeve or piece of pipe as shown. Tap each packing ring in firmly, staggering joints 45 or 90 deg. Tighten T bearing with a wrench

16 When assembly is completed, remove capscrew from bottom case and install a grease fitting. Use gun to force grease into fitting until it is difficult to rotate shaft, or grease is seen around sand cap. Remove grease plug; insert pipe plug

Plant

Electrical

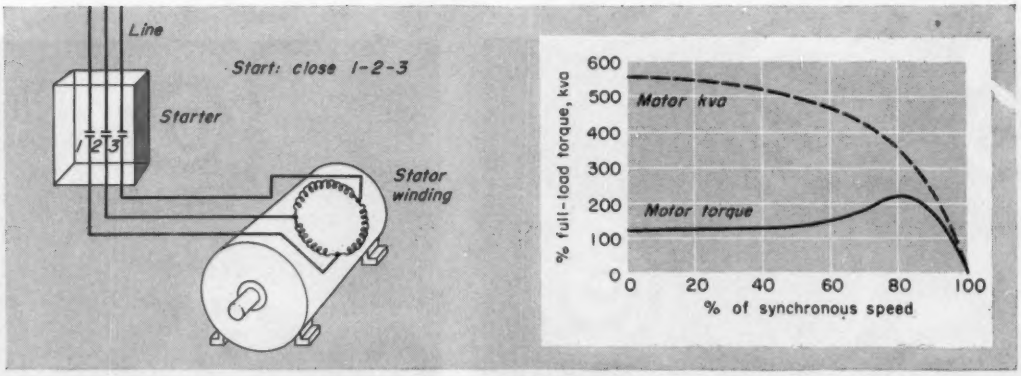
Fact File

No. 6: MOTOR STARTING

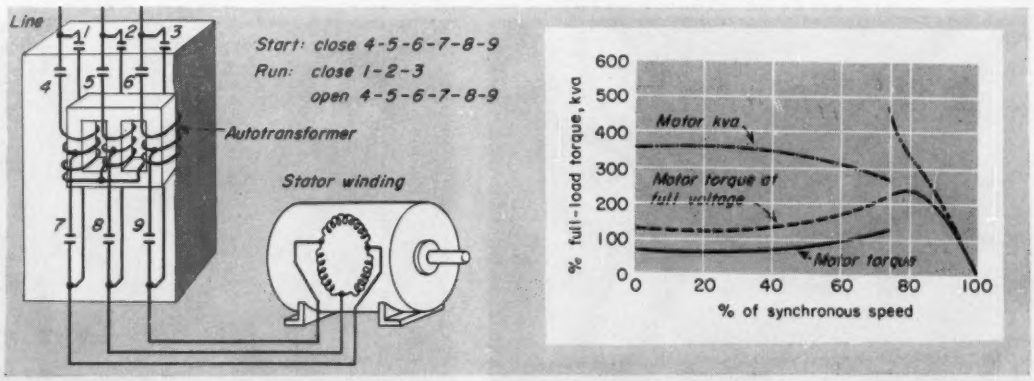
5 ways to start induction motors

By NORMAN PEACH, *Assistant Editor*

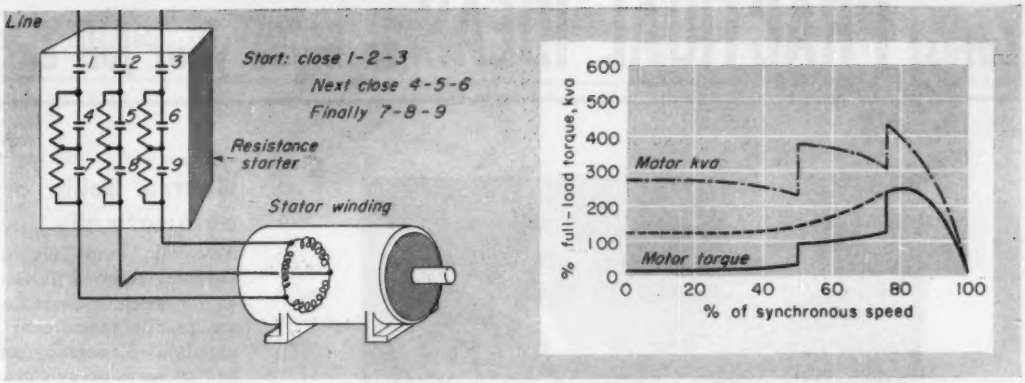
► YOU DON'T NEED a starter to protect an induction motor from burning up on full voltage. Two main jobs of ac starter (apart from switching on and off) are to limit current surge on line and permit smooth acceleration of machine that's being driven. The following five starting methods are widely used in the U.S. Sometimes they're modified to meet specific starting problems. A sixth method, common in Europe, connects winding in wye for starting at full voltage. When motor is approaching full-load speed, windings are reconnected in delta.



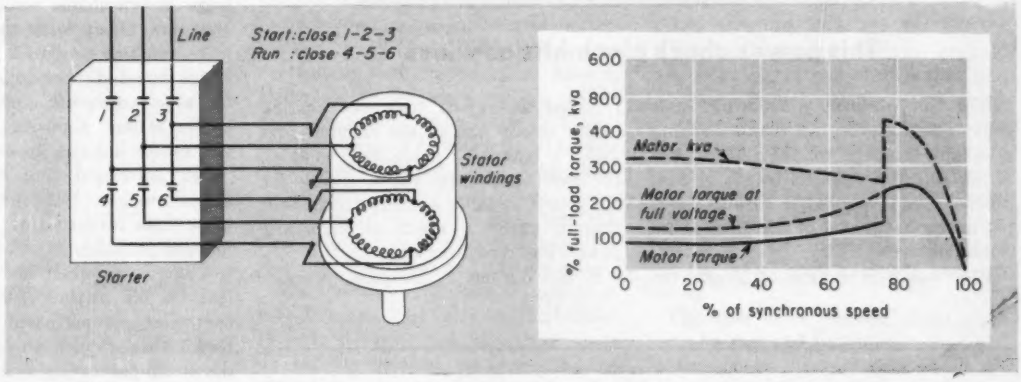
1 ACROSS-THE-LINE. Simplest way to start induction motor is at full voltage. Since modern motors are designed to stand shock, motors of several hundred horsepower are sometimes started across the line. Full-voltage starting is impractical if utility won't permit large starting-current surge, or where starting current causes troublesome voltage dip in plant. Very often the driven machine can't stand mechanical shock of across-the-line starting torque, and reduced voltage starting is employed to get smooth acceleration of load.



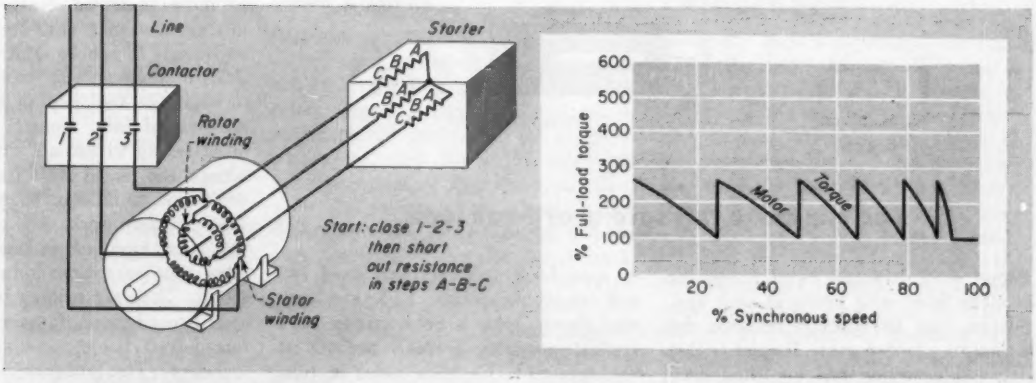
2 AUTOTRANSFORMER (compensator). Manual or automatic operation connects motor to autotransformer taps and autotransformer to line when starting. Motor is switched over to line at about 75% of synchronous speed, and autotransformer is disconnected. Autotransformers have two or more taps available so you can set compensator for starting requirements of load. Choice of voltage taps gives range from 65% to 80% of line voltage. Advantages of compensator are lower power loss, lower line current and less radiated heat.



3 **SERIES-RESISTANCE.** Reactance or reactance-resistance combinations are sometimes employed instead of resistance. Circuit is closed throughout starting period, the contactors closing in sequence to short out resistance. Reactor-resistor arrangements reduce sharpness of steps, produce smoother speed-torque curves. Power loss and initial expense of equipment make series-resistance (or reactance) starting less popular than compensator starting except where series-resistance characteristics are especially to be desired.

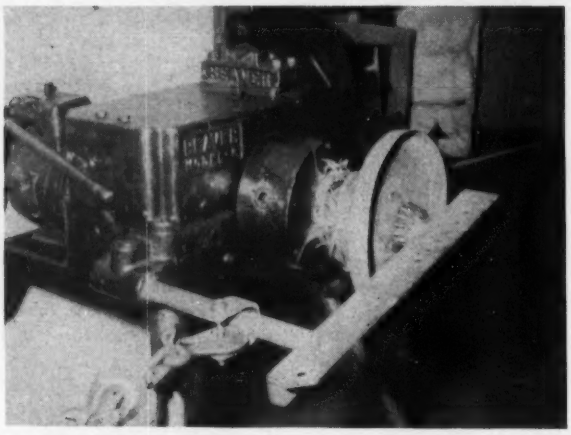


4 **PART-WINDING.** This method, which is gaining in popularity for large motors, has lower first costs, but motor must be designed for part-winding starting. Windings are divided into sections such that motor will start on one section. Other sections are connected in parallel until all are operating when motor is up to speed. Impedance of single section is high enough to limit starting current when full voltage is applied. Paralleling additional sections reduces impedance as motor speed climbs until last step completes winding.



5 **WOUND-ROTOR RESISTANCE.** Inserting resistance in rotor circuit cuts starting current while starting torque is kept high. Method is good for accelerating high-inertia loads. Many steps are readily obtained by using drum controller. Where resistance is employed for starting only, rotor winding is short-circuited in run position. If speed control is included, part of resistance remains in circuit and power is lost in it. Resistors designed only for starting duty won't stand up under continuous speed-control service current.

Latest PRACTICAL IDEAS to make your job easier . . .

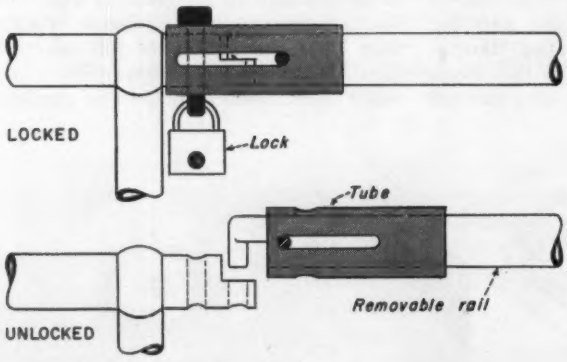


This power chuck pinch-hits as winch

I had the problem of moving some heavy equipment in our plant. Lacking a suitable winch, I welded a 10-in. disk to the end of a one-foot length of 2-in. pipe. Then I inserted a surplus bearing in the flange end of the pipe, photo shown above.

Pipe was held in jaws of power vise. I added a support from the bearing to the steady bar on the machine. By using a length of cable and hook on the improvised drum and a shackle for tying to a suitable anchor, (post, floor ring or such) a winch of surprising power was ready for use.

V BLANCHARD *Abington, Mass.*



You can make this safe guard-rail lock

Some steel railings have removable sections fitted with hooks at each end. Section can be quickly removed for access to guarded area. Danger is that detachable section can be lifted accidentally, hooks disengaged by a man standing and leaning over the rail.

We made sliding-tube device, sketch, to avoid accidents. Use short length of steel tube to slide on the rails outside to span hook joint between fixed rail and removable section. In locked position shown, tube is held axially by a vertical pin with a small padlock at its lower end. To align holes in tube and rail, and to confine tube to sliding movement needed, screw a headed pin into removable rail. This engages with an elongated slot in the sliding tube.

C T BOWER *London, Eng.*

Control boiler draft automatically

Automatic controllers are moved by impulses received from some portion of the system requiring control. These are usually pressure or pressure-drop impulses. Generally, static pressures and pressure drops obey the parabolic law because of association with air or gas flow. Hence, impulses available to controllers are of large magnitude at high ratings. They are of very low magnitude at low boiler ratings. Draft losses across fan dampers obey the same general law. Hence, these losses are small at heavy boiler loads and large at low loads.

At low boiler loads these characteristics combine to give a weak impulse to the automatic controller and a need for a very accurate and sensitive controller action. Knowing all this helps you devise linkages to overcome them.

For pulverized coal or other fuels difficult to burn in suspension, use impulse from furnace draft to control the induced-draft fan. Don't use it to control the forced-draft fan though. Control f-d fan directly from the master controller, proportioned to the fuel feed. This applies at low ratings on the steam-generating unit because then the flame is unstable and a slight increase in air flow makes it more so. When flame failure occurs, the furnace gas is rapidly cooled and the furnace suction valve is greatly increased. If the increased suction valve reduces induced draft, flame can usually be depended on to restore itself. If it's used to increase forced draft, the fuel-air mixture becomes still leaner and it's impossible to restore ignition.

With stokers, you must force air through the fuel bed to burn fuel at the desired rate. Control systems are often set up so furnace draft impulses actuate the forced-draft fan. Then you don't have to enlarge holes in the fire. This principle works well except where you must have ashpit doors open for some time to remove refuse from the ashpit. Then air rushing through such open doors reduces furnace draft. And forced-draft fan reduces air supply to fuel bed. This reduces boiler rating.

If you use furnace-draft impulse to actuate the induced-draft fan, air rushing through opened doors reduces furnace draft. But this air immediately increases the induced-draft value caused

keep your plant in tiptop shape

STEVE ELONKA, *Associate Editor*

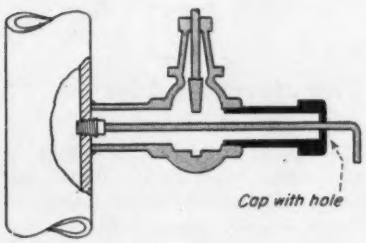
by fan. So it will not reduce air supply to the fuel bed. Rating on the boiler can thus be maintained even though greater quantities of excess air pass through the boiler.

For sensitive control at low boiler loads, arrange the automatic controller mechanism to start opening dampers when the mechanism is on dead center. This increases angular velocity as the damper is open with constant velocity in travel of controller's power piston.

When burning pulverized coal, the automatic controller used to regulate furnace draft should always actuate the induced-draft apparatus. Regulate forced draft by master controller and proportion it to fuel feed.

When operating stokers where ashpit doors must be opened often for cleaning, use the furnace draft controller to regulate the induced draft.

LV ANDREWS *Worcester, Mass.*



Here's better way . . .

to remove plug from live line. D W Antonacci made up a sketch of how he did it, in Oct, p 140. I'm showing his sketch here, but have added nipple and pipe cap, shown in black. After you weld valve onto live line as he did, screw on nipple and cap so rod sticks out of drilled hole. Now you can screw out plug safely, pull out far enough to close valve. Steam blowing out around pipe cap's drilled hole won't hurt you.

H STONE *Bauxite, Ark.*

Have you noticed . . .

that the slipring carrying the negative dc current to the field on an alternator eats or wears away much faster than the ring on the positive side? Reason is that metal of negative ring is depositing, or trying to deposit, on the brushes.

Many operators are wise to this condition. Some are not. To keep wear even, reverse polarity. That is, swap leads to the rings every year or two.

L MCWILLIAMS *Quebec, Can.*

What would you have done?

As operations officer in an Engineers' pipeline company in Korea, I had the job of erecting a 3000-barrel water-storage tank. We had all the parts to a standard tank, promised to have it assembled within ten days. On checking, however, I found we didn't have sealing compound, which is always a must on steel bolted tanks. Compound is especially needed for bottom seams and outer chimes. So here was the usual snafu. Best we could hope for was a 5-day shipment from Japan.

We erected the tank, hoping it wouldn't leak like the proverbial sieve. In four days we had the three rings up and on the sixth we completed the top, then started pumping in water. It leaked as expected. On the seventh day, with almost six feet of water, we got our shipment of sealant. But I hated the thought of emptying the tank, what with the urgent need for it and pressure from top brass.

We tried wooden wedges, asphalt, just about everything, but couldn't stop the leaks from outside. I was ready to drain the tank when my operations sergeant popped up with, "Sir, I know a guy who goes in for skin diving. It just happens he brought his goggles with him to Korea. How about running an air line from the compressor into the tank. He'll go inside and seal her up."

The skin diver entered about eight feet of water and patched up the leaks in four hours. He not only saved my hide and the Corps of Engineers, but also got a much deserved extra stripe. What would *you* have done?

H C ZWART *Clifton, N. J.*

I don't agree

Don Cochrane had a good idea, Feb, p 130, when he installed a sign to caution the grinding operator to wear safety goggles. But I believe transparent plastic shields over the grinding wheels are much better. Shields offer protection to more than the eyes. Also, when the operators are alone on the shift, they often won't take the trouble to put on safety goggles for a small job. Signs help, but they are too often ignored, so shield is best answer.

R J ANDERSON *Winona, Minn.*

EDITOR'S NOTE: *Anderson has an important point. Can any reader send us a good photo of a mechanic using a plastic-shielded grinding wheel? Many plants have them on all their wheels.*

Have you heard . . .

about the guy who wanted top-flight illumination for the full 24 hours in his mine station? So he brought in 250 v from the traction system for normal service. Then he used 230-v ac for between-shifts and holiday service, which he usurped from a control transformer on nearby primary pump.

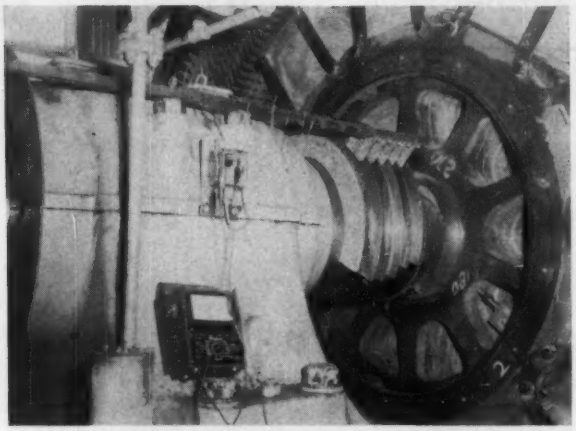
Well, it was a 20th century marvel all right for all to admire—until the cool descending shaft-air met the very moist tunnel-air. That filled the feeder conduit with condensed moisture. The fireworks were impressive when dc and ac fought it out. The transformer came out a total loss. Fireworks flew in the manager's office too, and he also lost.

P C ZIEMKE *Oak Ridge, Tenn.*

(*For more Ideas, turn page*)

More PRACTICAL IDEAS

Begins on page 120



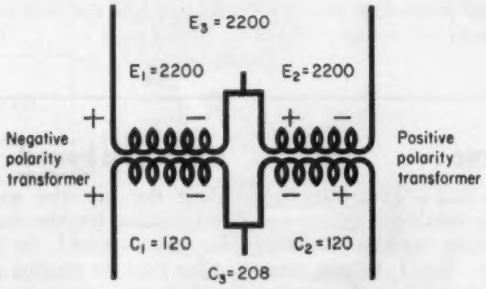
Here's your 'trick' of the month

Photo shows a temporary setup-collar mantled shaft for 15,000-kw 25-cycle frequency changers. This temporary rigging allowed us to do a pole-drop test on the field of this machine with field rotating. Arrangement saved us plenty of money in preventing galloping short in machine's field as a source of serious vibration. It may be an old idea, but it was a new one to us.

Machine had a long vibration history, which appeared to be field excited. It was finally pinned down to three difficulties: (1) an open gap in the 2-piece stator (2) loose iron in the stator (3) and a stator frame that happened to be in resonance with the 50-cycle vibration, resulting from the open gap in the stator frame.

We were going to dismantle the 40-ton field, and check it for shorts. But these rings saved time and money. Photo shows only top half of the collector rings. Each ring was fabricated from annular pieces of plywood clamped and bolted to the shaft. We used ¼-in. steel plate for temporary ring. Brush rigging shown was put together from some old contacts we had in shop.

C T EYRING *Phoenix, Ariz.*



Reversed open-delta transformers

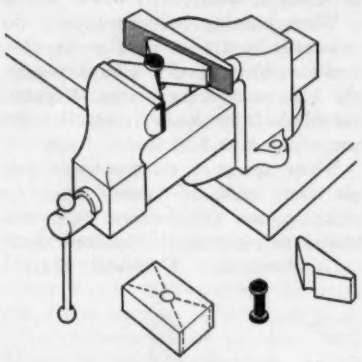
Most electrical men are familiar with the open-delta transformer connection. Here, if one transformer fails in a bank of three, the other two transformers can be open-delta connected to obtain 57.7% of the bank capacity. This connection is used largely on metering and relaying installations, but this is where most errors are made.

Although the connection is simple, it's surprising how often one runs across the *reversed* open-delta. It comes from a workman making wrong connection, and sometimes from using transformers of opposite polarity. In the past, some manufacturers made all their transformers with a negative or subtractive polarity, others with a positive or additive polarity.

Sketch shows result of connecting two transformers of opposite polarity in open-delta. To make things right, just reverse the leads of one transformer on the secondary side.

It's good practice to check the polarity of each transformer before connecting. Then check again with a voltmeter (use potential transformers if required) after voltage has been applied to the primary side. For power circuits, motors will run along OK with 1.73 times normal voltage on one phase. But when an incorrect delta is used for metering and relays, you'll know pronto that something is wrong.

L MCWILLIAMS *Shawinigan Falls, P.Q.*



Vise attachment for taper work

For handling wedge-shaped work in vise without movable jaws, make this handy attachment, sketch. Use rectangular iron block. Drill hole, then cut out two wedge-shaped pieces and make a hinge pin. Then you'll have another hand shop-helper.

C H WILLEY *Concord, N. H.*

Old newspapers do the trick

For skimming oil off surface in our hotwells I use a sheet of newspaper. Lay it on surface of water that has an oil film. Oil sticks to paper. For a lot of film, you may need several sheets.

T MULLIN *Seattle, Wash.*

EDITOR'S NOTE: *This advice may be OK, but some careless person may let the newspapers distintegrate. Why not use a strainer in your feed pump's suction line? Or place a small observation tank with sight glass to show oil floating on water. Discharge from condensate pump flows onto sponges in half of this tank. Only clean water escapes through partition opening at bottom into clean side. From there, condensate goes to feed-pump suction.*

(*For more Ideas, turn page*)

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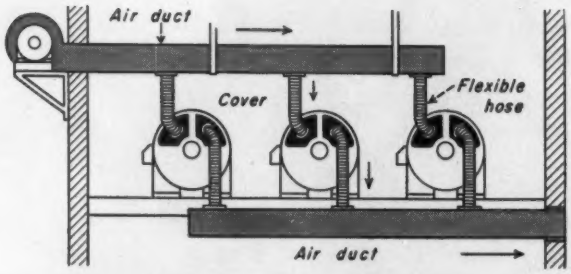
More PRACTICAL IDEAS

Begins on page 120

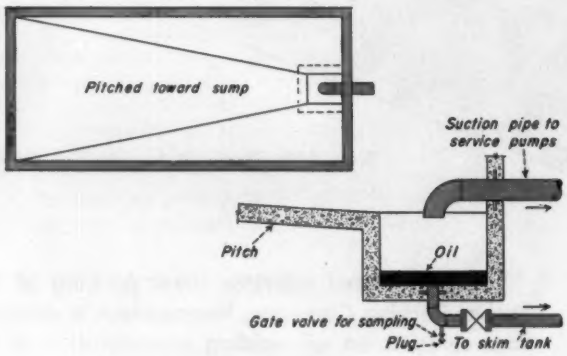


Now our induced-draft fan's motors are cool and clean

Upper part of our fire room is a hot spot for induced-draft-fan motors. They were hot, sooty and needed a lot of maintenance.

We solved this problem at our plant by putting tight covers on the inspection plates, sketch. Then we installed a duct for clean air and a fan to supply the air through flexible tubing, as shown. This improvement cut down maintenance to almost zero.

T MULLIN *Seattle, Wash.*



Pipe your fuel-oil tanks for troublefree service

One of our steam-power plants was erected on filled ground. Outfall tunnel for condenser cooling water was a massive concrete structure, used also as foundation for fuel-oil service tanks and fuel-oil service pumps.

Instead of high and low suction of fuel-oil service pumps, concrete service tank had a sump at one end, sketch. Tank's bottom was pitched so oil drained to sump. Suction pipe's elbow was below lowest point of tank's floor so tank could be pumped dry. Drain line from bottom of each sump led to a collecting system for pumping oil and water mixtures to a skim pond. Upstream from the plug cock in the drain pipe, a half-inch valve was installed. That took samples to check if water collected in sump. This valve was kept plugged except when taking samples.

Main fuel-oil storage tanks were cylindrical steel, above ground, with tank area enclosed by fire walls. Suction pipe of each tank also had elbow inside the tank, with open end 12 inches above tank's bottom. These tanks had bottom drains and sampling connections with their valve in the concrete pit under the tank.

T LIVINGSTON *Los Angeles, Calif.*

Did you know . . .

that much of the trouble in removing a nut from a stud is that threads, sticking out of stud rusts, get clogged with paint, etc?

One way to prevent this is to saw off excess portion of stud flush with nut's top after drawing nut down tight. Then dab a coat of paint over stud's cut end and top of nut. Burr caused by hacksawing the stud is easily removed first time nut is backed off.

A PERLINGER *Pittsburgh, Pa.*

Stretching life of quarter-turn belt drives

Quarter-turn drives serve where nothing else will do. But these drives are heir to a few basic troubles. Unless you correct them, both belt and pulleys wear needlessly. One trouble is that much side pull is exerted, running belt crooked. One edge of belt is stretched more than the other. Unless corrected, belt is soon ruined. First warning of impending trouble is failure of joint lacing. This is especially true of metal-clip-type lacing or fasteners.

Where belt centers are fairly long, turn belt over in a half twist, or 180 deg. This little stunt causes belt to change sides every other revolution, distributing the wear. Besides, stretch is equalized uniformly and there's no abnormal wear on splice.

Layout engineer should have quarter-turn drives arranged so centers are at least five times the diameter of largest pulley. Example: Largest pulley's diameter is 20 in. Shaft centers should then be at least 100 in. apart.

Well-planned quarter-turn drives deliver their full horsepower rating. Yet it's smart to use a belt 3 to 10% wider to insure long, troublefree operation. Best operation is with drive pulley on vertical shaft. This is because belt's tight side runs over pulley on horizontal plane. But slackness causes trouble.

Where vertical pulley is the driver and belt runs off, taking up slack is one way to correct the trouble. Should that fail, increase crown on pulley of vertical shaft. Belt dressing helps.

P C ZIEMKE *Oak Ridge, Tenn.*

Ditto sheets . . .

can be used as inexpensive blueprints. Advantages are: varied colors, economy for large number of prints, speed of reproduction. Use them for wiring diagrams to paste into panelboards, for special machine-shop work, graphs, maintenance forms, installation drawings on large construction jobs. Also for power-plant operation and maintenance. Special master can be obtained with forms partly completed.

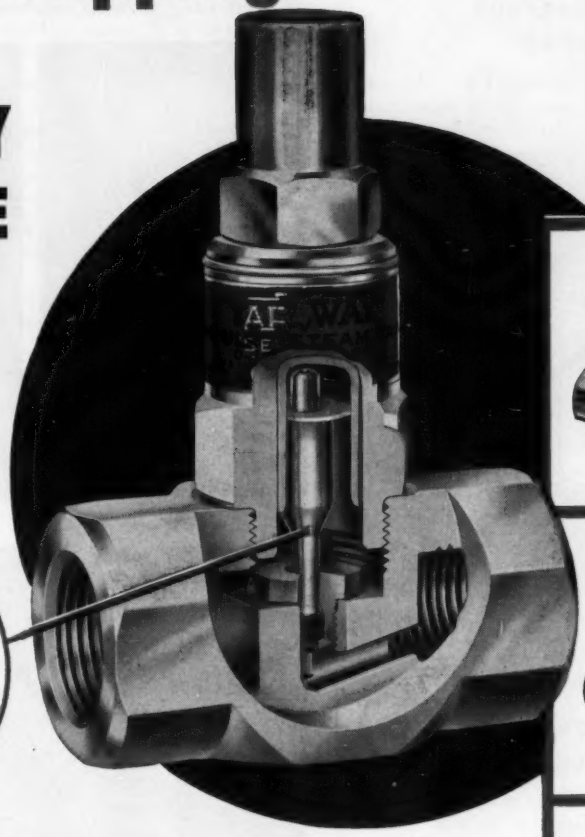
G S COBLENTZ *Los Angeles, Calif.*

My biggest boner

Please turn to page 182

the impulse that revolutionized steam trapping

YARWAY IMPULSE STEAM TRAP



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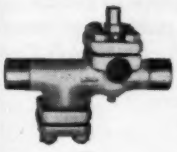

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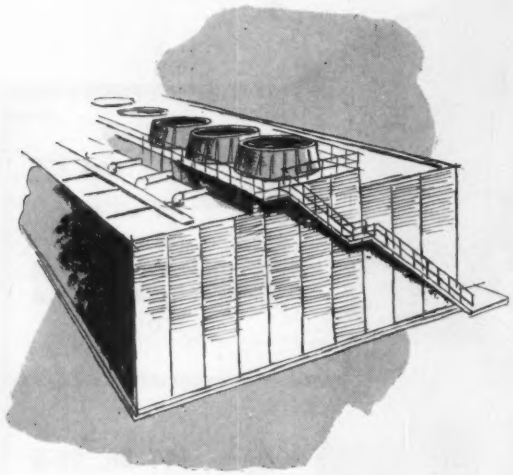
Have a PLANT PROBLEM? *Tap the*



The question

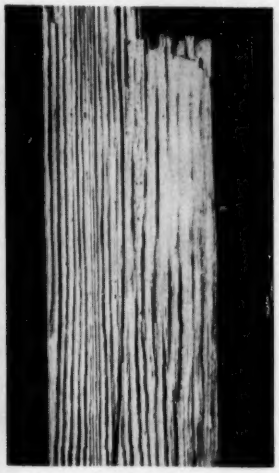
How can we protect cooling-tower wood?

About seven years ago our industrial plant installed a mechanical-draft double-flow cooling tower to handle our cooling-water needs. Tower is made of California redwood.

In a recent inspection we noticed that some wood areas are bleaching out white and are in a fibrous condition. Checking further, we were told that lignin in wood—the substance that binds fibers together—could be dissolved by sodium carbonate in our cooling water.

We're using zeolite treatment for our water and feel that we're already taking adequate precautions. But since our cooling-tower wood appears to be deteriorating, we'd like to get the opinions of readers on how to protect it. What should we look for in water conditions?—*CWI, June, Power*

The answers



Location of wood attack can tell *CWI* the cause

Location of the trouble in *CWI's* cooling tower can tell him what to look for. For instance, if the deterioration is in an area of the tower where complete evaporation takes place, the problem can probably be solved by hosing down to remove harmful salt concentrations, lower photo, above. Periodic inspections and regular preventive maintenance will avoid further attack from this source.

If trouble is in flooded sections of the tower, the problem is probably caused by high alkalinity in the circulating water. High pH values show up this condition. Result is delignification of the wood, top photo, right. Sodium carbonate and bicarbonate dissolve the redwood's lignin content.

Zeolite treatment of tower makeup water doesn't remove alkalinity. It actually increases water's solids content. Thus it's possible that very high alkalinity is due to solids concentration. If this is the case, *CWI* can restrict pH and alkalinity to desirable ranges by adding sulfuric acid to the circulating water.

In addition, if tower water is chlorinated, *CWI* should be sure to maintain less than one-ppm chlorine residual in return water to the tower. Strong oxidizing agents like

know-how of over 45,000 Power readers

HOWARD KALLEN, *Associate Editor*

chlorine are known to cause delignification. And high chlorine and high alkalinity in combinaton are very actve in removing lignin from wood.

Fungus attack is also common, top photo, left, facing page. It's often difficult to tell it from chemical attack. *CWI* should have a competent engineering specialist examine a sample of the wood. Also, the circulating water should be analyzed to find out the types of algae, fungi and bacteria present.

Another possibility: combination of chemical and biological attack on the wood. Chemical attack often precedes and stimulates biological attack. Chemicals remove natural toxic materials from the wood. In this case, eliminating conditions that cause chemical attack will not necessarily prevent biological attack.

Chlorine and algicides are effective in controlling many forms of microbiological life.

Further complicating the problem: Mechanical erosion can take place once the wood surface has been weakened.

J M DONOHUE, *Engineer*
W H & L D Betz, Philadelphia, Pa.

Here's what we found

We recently inspected a cooling tower where serious deterioration had occurred aften ten years of service. The water contained a high concentration of sodium carbonate. Tower lumber consisted of untreated redwood and treated fir. Deterioration was confined to untreated redwood. Fir lumber showed no sign of attack.

Evidence tends to support the theory that sodium carbonate may accelerate the leaching of toxic extractives. This leaves the redwood vulnerable to biological attack. Avoiding sodium carbonate from the start is certainly desirable. Discontinuing it later may have questionable value. Best solution may be to apply preservatives to kill the infection and prevent future attack. This can now be done to an existing tower. Chemicals are diffused into the wood where they react to form insoluble precipitates that are toxic to the wood-destroying organisms.

D R BAKER, *Manager Technical Service Dept*
The Marley Company, Kansas City, Mo.

Hold pH between 6.5 and 7.0

The answer is to reduce alkalinity of the circulating water by adding enough sulfuric acid to hold pH between 6.5 and 7.0. Amount depends on the evaporation rate and characteristics of the water supply. A simple, practical method of control is to maintain the circulating water between 75 and 100 ppm total alkalinity. This can be determined by titrating a 50-cc sample with 1/50-normal sulfuric acid, using methyl orange as an indicator. With this size sample, total alkalinity is: 20 × cc's of titrating acid used.

Thus, titration should run between 3.8 and 5.0 cc of normal sulfuric acid.

Excessive acid feed must be avoided to prevent corrosion of metal in the system. For best results a corrosion inhibitor like sodium dichromate should be used.

R W HAWKSLEY
Ray W Hawksley Co, Richmond, Calif.

Run chemical analysis of the cooling water

Basically, *CWI's* tower sounds like it's suffering from delignification of the wood. Other types of wood failure result from attack by biological organisms. But bleaching of the wood leads me to suspect that the failures are delignification due to high pH and carbonates in the cooling water.

First step in attacking this problem should be a chemical analysis of the raw and recirculated waters. Periodic analyses would establish pH, sodium, calcium, carbonate and bicarbonate contents of the water. *CWI* should start this program immediately.

The right treatment can be determined from chemical analysis. High sodium carbonate and bicarbonate, for instance, can be treated with sulfuric acid. Increased blowdown should also be investigated.

Sodium-zeolite treatment may be detrimental in this case. As the metal ions, calcium and magnesium, are exchanged for sodium, the pH may increase slightly. Depending on the raw water's chemical content, it may be more desirable to stay with the original calcium and magnesium contents and employ anti-scale treatments.

It will also pay *CWI* to investigate the possibility of biological attack. Failed wood samples may be examined for indication of attack from this source.

J W BISHOP
Mineola, N. Y.

Sodium carbonate could be causing delignification

Zeolite softening of the cooling-system makeup waters is usually applied to relatively hard raw water. This is certainly a good practice for conserving water, which is scarce in many areas.

But when sodium-zeolite resin is used to soften waters of such hardness, relatively high sodium-bicarbonate concentrations may result in the cooling water. Sodium-bicarbonate content of makeup water is multiplied by the number of cycles of concentration permitted in the cooling water. Recirculation of cooling water usually results in a breakdown of sodium bicarbonate into sodium carbonate and carbon dioxide. The carbon dioxide is lost to the atmosphere, leaving relatively high concentrations of sodium carbonate in the cooling water.

Presence of sodium carbonate is the usual cause of serious delignification of the cooling-tower wood.

Thus, complete cooling-water treatment must (1) prevent scale (2) inhibit corrosion and pitting (3) prevent algae and slime from forming (4) prevent attack on wood portions of the cooling tower.

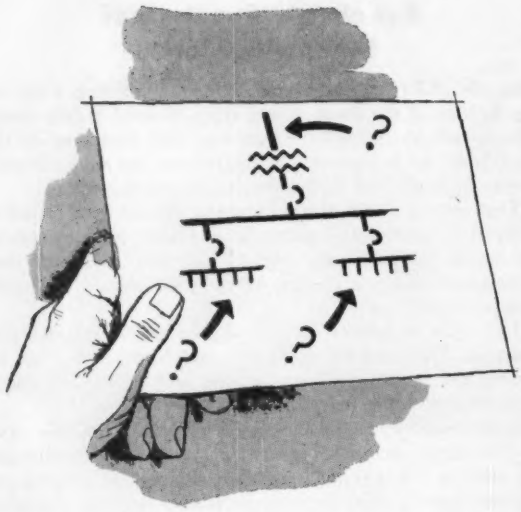
L H CARVER
Deady Chemical Co, Kansas City, Mo.

Want to cure your plant problems? Send in your design and operating headaches to us. We'll give *Power* readers a whack at them.

Turn page for info on group lamp replacement

More PLANT PROBLEMS

Begins on page 126



The question

Where should shunt capacitors be located to improve power factor?

I'm plant engineer for a metal-working plant that's expanded gradually over the past ten years. Biggest part of the added electrical load has been in relatively small induction motors. As a result, our power factor has dropped to about 72%. And the local utility company penalizes us for it. Their penalty factor is: Billing demand = (90/pf) × metered demand.

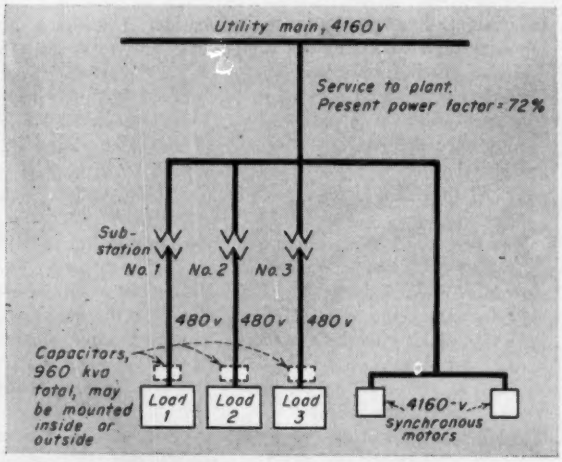
Our metered demand runs about 2000 kw. Power company's rate structure is such that our bill is about $3800 per month.

Electricity comes in at 4160 volts. It is stepped down at primary substations to 480 volts, except for power used in two 250-hp synchronous motors to drive air compressors.

In addition to power-factor penalty we also face this problem: Some plant feeders are carrying more than their full-load rating.

Can readers tell us how much we can afford to invest in shunt capacitors? Where should we locate them for best results?—*WCD, June, Power*

The answers



Raise power factor to 90%

To raise the power factor from 72 to 90% requires 48% of the metered demand:

$$2000 \text{ kw} \times 0.48 = 960 \text{ kvar}$$

To raise the pf to 100% requires 95% of the metered demand:

$$2000 \text{ kw} \times 0.95 = 1900 \text{ kvar}$$

The 90% pf—the point on the billing schedule where there is no further penalty—results in a billing demand that's equal to metered demand. The existing billing demand is:

$$90/72 \times 2000 = 2500 \text{ kva}$$

Thus 90% pf reduces billing demand by 500 kva, or 20%.

By increasing pf to 100%, billing demand drops to 1800 kva, a decrease of 700 kva, or 28%. Since *WCD* will realize an additional saving of only 8% by going from 90 to 100% pf—at almost twice the investment—he should install only the 960 kvar necessary to boost pf to 90%.

Assuming the synchronous motors are drawing the maximum reactive kva, no capacitors are needed on that line. If all substations shown have equal loadings and their power factors are equal, *WCD* should divide the capacitors equally and install them as near the load as possible. Feeders are then relieved of 960 kvar (total), which they are carrying.

WCD should check loads and pf at each substation to determine the amount of capacity necessary for each load. He may find it would be economical to increase the pf of some feeders to 100% to relieve possible overloading.

W H KEITH — *Albany, Ga.*

Consider these factors in locating shunt capacitors

The easy solution to how many kvar are required can be found in published tables that furnish constants:

From 72% to 90%: $0.4796 \times 2000 = 959$ kvar

95%: $0.6352 \times 2000 = 1270$ kvar

100%: $0.9639 \times 2000 = 1928$ kvar

It takes almost as many kvar to go from 90 to 100% as from 72 to 90%.

Location of capacitors on the plant system is partly an economic and partly an engineering problem. For lowest first cost and reduction in billing demand, they'd go on the 4160-volt bus, on the plant side of the meter. This would

(*Continued on page* 130)

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125 hp

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- Easy to install
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- No freezing problem
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- Constant speed or dual control
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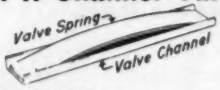

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Found only on I-R compressors

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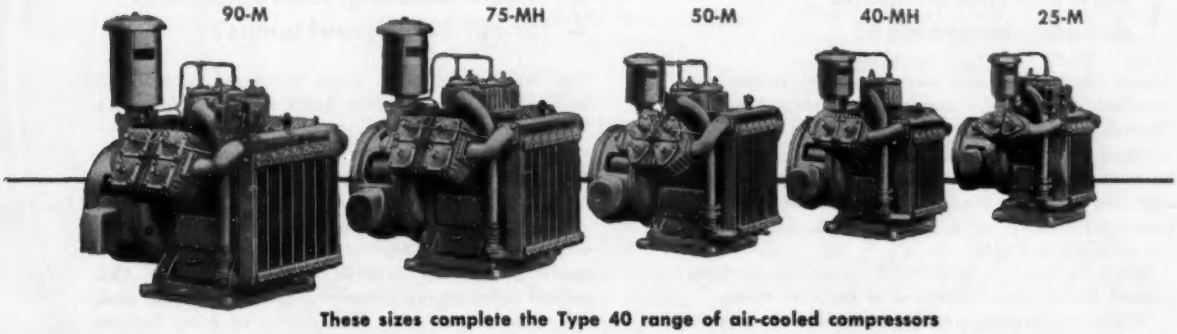

These sizes complete the Type 40 range of air-cooled compressors

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COMPRESSORS • GAS AND DIESEL ENGINES
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Begins on page 126

not relieve the overloaded feeders but would reduce the billing demand.

Maximum benefit would result from putting the right size capacitor at each motor or welding machine. This would improve power factor, remove magnetizing current from the feeder circuit and raise voltage at the motor. The capacitors would be switched off and on with the motors. But such an arrangement would require the highest initial cost. *WCD* should remember to reduce motor protection fuses to compensate for removal of magnetizing current in the motor branch circuit.

An intermediate location would require a study of each feeder circuit to locate several groups of capacitors on each feeder. Such a solution would reduce pf and at least partly reduce magnetizing current in the feeders. Costs are less than for capacitors at each motor but more than for primary-voltage capacitors on the 4160-volt bus. The best solution might well be a combination of all three locations.

Regardless of where the capacitors are located, remember that they are heat sensitive. Keep them away from steam pipes, furnaces. And provide good ventilation. Article 460 of *The National Electric Code* gives more information.

Usually, capacitors like *WCD's* pay for themselves in one to three years. Some of the capacitor installations I've figured pay a 20 to 40% return on the investment. The immediate saving for a correction to 90% is a 500-kw reduction in billing demand, times the rate schedule step. Even if less than full correction is applied initially, there is a monthly saving.

Unit costs for assembled units without controls vary from about $5.25 per kvar in outdoor pole-mounted 4160-volt 450-kvar assemblies to about $9.00 per kvar in 480-volt assemblies for feeder application.

W H MAPES — *Oklahoma Gas and Electric Co, Oklahoma City, Okla.*

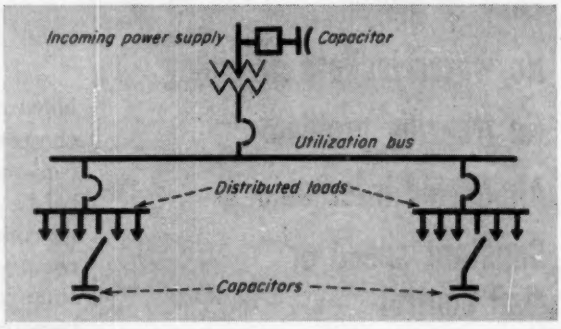
Find out reason for low pf before trying to correct it

The two main reasons for power-factor improvement are to: (1) reduce purchased power costs (2) increase electrical capacity in selected portions of the distribution system.

Generally, low power factor is due to partly loaded induction motors and shows up as a low-voltage condition. But low power factor in a large manufacturing plant can also be caused by a high-voltage condition, decreasing distribution capacity and boosting purchased-power costs. It's important to find out why pf is low before trying to correct it.

If the condition is due to high-voltage that increases the motor magnetizing currents, installing capacitors is a waste of money. If lightly loaded induction motors are the cause, installing capacitors will help. Remember, both conditions may exist. Thus *WCD* may have to cut down voltage level as well as install capacitors. First, voltage should be changed by means of the transformer taps, if necessary.

J SCHNEIDER — *Needham, Mass.*



Here's where I'd locate them

Besides power-factor improvement, capacitor installation would also result in: (1) increased system capacity (2) improved voltage conditions (3) reduction of system losses.

Diagram above shows where I'd locate them.

F J HOGAN — *Colombia, So. America*

Your September Problems

1 How can turbine-blade deposits be avoided?

About three years ago our municipal power plant installed a 10,000-kw condensing turbine-generator. Throttle steam is 400 psig, 750 F.

Recently, during a scheduled removal of the turbine casing, we found scale deposits on the high- and low-pressure blading stages. Our feedwater treatment consists of a hot lime-soda softener that was installed in 1936.

Since we have a relatively-low-makeup feedwater system, we find it economical to use city water.

While turbine-blade deposits weren't extensive, we don't want the condition to get worse. But we don't want to foot the bill for an entirely new water-treatment system, if we can possibly help it. Have *Power* readers suggestions to offer?—*SCS*

2 Should we use group replacement for our fluorescent lamps?

Our metals-fabricating plant is housed in a 5-floor building that uses almost 1000 fluorescent fixtures. These are 4-lamp units.

Up to now, we've been replacing these units when they burn out, rather than scheduling them on a regular basis.

Some plant engineers in our area are apparently sold on the group replacement system. But I'm not convinced it can actually save us money. Also, several different replacement schemes are being used. One plan is based on the number of lamp failures in a given area. Another replaces all lamps when they reach 80% of their expected life.

Are *Power* readers using these methods in their plants? How are they working out?—*IAR*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches.

RESPECTED STANDARD OF QUALITY

A refinery in Texas . . . a chemical processing plant in Louisiana . . . a high-pressure power plant in New Jersey . . . a classified project in California . . . a ship at sea . . .

Common denominator: danger to personnel and equipment from fluids confined in high pressure/temperature range.

Uncommonly good judgment: use FLEXITALLIC Spiral-Wound Gaskets to insure a safe seal.

The amazing flexibility of Flexitallic Gaskets compensates for the variable stresses encountered in service . . . prevents contamination where corrosive conditions exist.

Since 1912, engineers have been designing for safety with Flexitallic, the original Spiral-Wound Gasket. It's why we at Flexitallic work conscientiously to maintain this respected standard of quality.

Each Flexitallic Gasket is designed and engineered to meet specific conditions of thermal and physical shock, corrosion, vibration, weaving and unpredictable joint stresses. Spirally-wound V-crimped plies of required metal with alternating plies of proper filler result in a resilient gasket having controlled compression characteristics like those of a precalibrated spring.

Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure-temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000°F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285".

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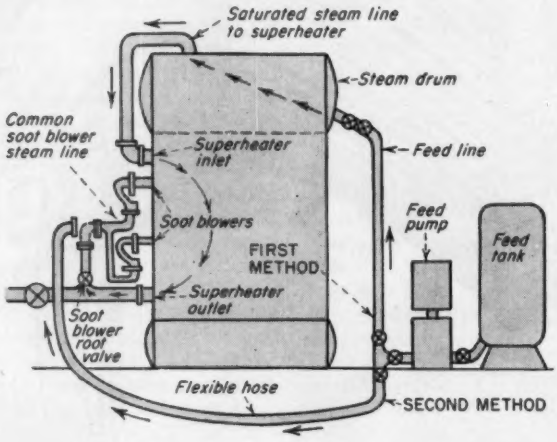
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Flexitallic is a registered trade name. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue*—it's our exclusive blue-dyed Canadian asbestos filler.

ARGUMENTS . . . *it pays to pop your safeties here*

ALTHEA THORNTON, *Assistant Editor*



I say this hookup cleans superheater best

Reader Gunner (May Arguments) can get water-washing pressure at his soot blowers by following my sketch, above.

First, line up 200-F water from the feed tank or other source to a reciprocating feed pump. Then, pressure the soot blowers by either (1) pumping water into the steam drum via the feed line through the superheater and into the soot-blower piping or (2) breaking the common soot-blower line, closing the soot blower root valve and connecting a flexible hose between pump and the common line.

When feed pump applies pressure, rotate blowers five to ten times. When water runs clear, secure the soot blowers and use the hand lance on areas where deposits still remain.

JOHN DAVIS *Los Angeles, Calif.*

Long retractable blower is the only answer

In the final analysis, removing a given deposit from superheater tube surfaces (p 140, May POWER) depends on kinetic energy. Gunner should look for the blower that brings the most kinetic energy to bear against his deposit.

The long retractable blower is the only type that proves consistently effective. It uses air, steam, water or any combination. Often it eliminates the need for water washing.

Except for very special applications, intermittent air blowing is not the answer, with or without water washing.

S F WALLEZE *Atlanta, Ga.*

Acid cleaning does the job better

Use acid to clean the inside of boiler tubes. Compared with mechanical methods, acid cleaning (1) needs less down-time (2) eliminates extensive dismantling of boiler components (3) can often be applied through existing boiler connections (4) easily handles small-diameter tubes.

There are two methods, circulating and soaking. Each has advantages. Acid washing is also used to a lesser extent for cleaning the outside of boiler tubes.

Steam and air soot blowers are widely used for cleaning the outside of tubes. Air blowing is less messy, but usually involves more equipment, thus increasing investment cost.

H B WAYNE *Brooklyn, N. Y.*

Let's figure chimney height from boiler outlet

Back in the 1920s, the grate line was the basis of chimney-height calculations. No doubt many chimneys are incorrectly designed on this basis.

But the boiler outlet damper should be the base for calculations. I am glad to note that this will be incorporated in the 1957 ASHAE *Guide*. Let me illustrate with a simple problem.

Assume two chimneys attached to identical industrial stoker-fired boilers with the same flue-gas temperature, draft loss, friction factor for interior chimney surface, inside chimney diameter, elevation above sea level, construction and air infiltration.

We can then limit the problem to flue-gas temperature and boiler-draft requirements. Assume flue gas at 600 F, outside air at 80 F in summer. Negative furnace pressure .10 in. of water, and draft loss through the unit .90 in. of water at maximum load.

Neglecting chimney friction and other items mentioned above, $H = D/K$; where H is height in feet, D required draft, in. of water, and K a factor depending on temperature differences. Then $H = 1.00 / .007 = 143$ ft.

If the boiler outlet damper is 30 ft above the grate line, and this is 3 ft above the operating floor, chimney top is either 176 or 146 ft above the operating floor. If the diameter is right, friction loss in the chimney adds but a few feet to the required height. Air infiltration adds to the volume and reduces the temperature, but the big difference is selection of the right starting point.

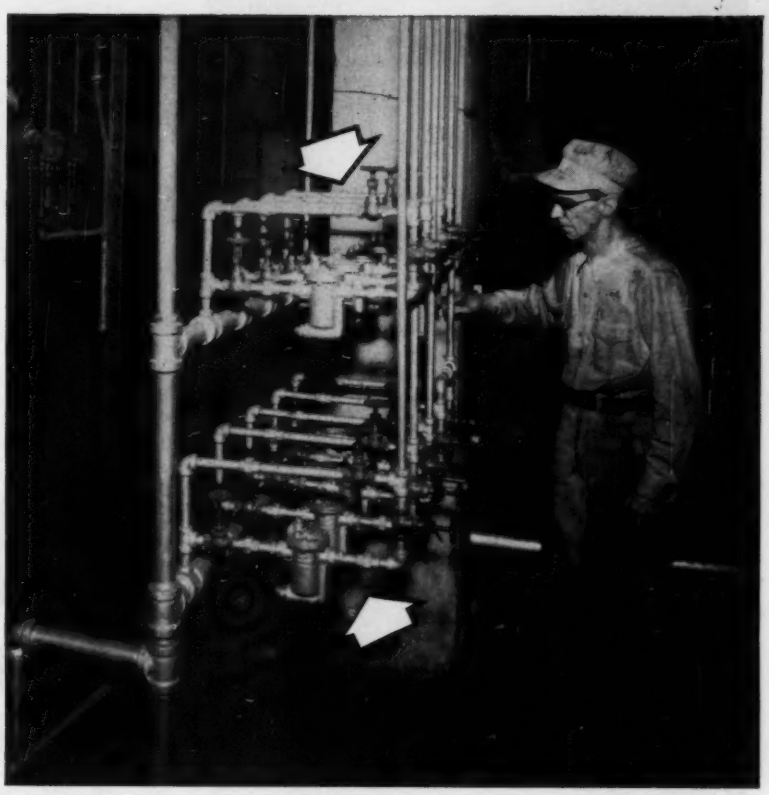
Boiler manufacturers define draft loss through the boiler as the difference between furnace pressure and pressure at the boiler outlet. I feel certain careful analysis will verify that this draft loss is a combination of friction and chimney effect within the boiler.

Some people feel draft loss is friction loss only. But they fail to realize that friction loss is greater than draft loss through the boiler.

F A BERGEY *Detroit, Mich.*

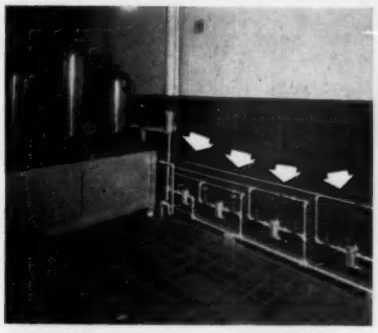
What's your argument?

Do you agree with everything in this magazine? You needn't. Shoot in your opinions; we pay if we print your letter.



Good Trapping Practice with Good Traps Roy Davis, Maintenance Superintendent, looks over one of the well-engineered Armstrong trap installations he has made at the Masonic Temple in Detroit. Traps discharge to 15" vacuum.

Keeping the Coffee Perkin' with Armstrong traps draining steam heated coffee urns.



Detroit's Masonic Temple Solves Vacuum Loss by Installing Armstrong Inverted Bucket Steam Traps

■ MANY AN engineering hour has been spent ferreting out the leaks in a vacuum return system. Here's a tip if you have the problem: *check your steam traps.* Don't worry about *flash* steam from traps—look for the traps that are leaking *live* steam. Take the case of the big Masonic Temple in Detroit:

The 11,600,000 cubic foot building has banquet space for 4500 persons at a sitting. Imagine the bedlam in the kitchen when the steam heated cooking equipment couldn't meet dinner schedules!—simply because condensate drainage was sluggish. The cooks were always in a stew and calls to the maintenance department were daily occurences.

The building buys 35 lb steam from Detroit Edison. Line pressure is used for the cooking kettles, while regulating stations supply 2 to 3 lb steam for the heating system.

Couldn't Hold Vacuum

Prior to the installation of Armstrong traps, maximum vacuum attainable was 4 inches and in some cases it was necessary to manually drain the systems and dump the condensate.

According to Roy Davis, Maintenance Superintendent, the installation throughout of Armstrong inverted bucket steam traps has solved the problem. "*I don't remember having had the chefs complain since . . . the kettles heat in a hurry now.*"

F. W. Emblin, Operations Manager, adds, "*You can check the vacuum gage any time now and seldom find less than 15" showing.*"

There's another nice part to this story that only time will reveal: Armstrong traps have a habit of delivering this kind of service on low pressure vacuum return systems for years and years without repairs. Your local Armstrong Representative has plenty of cases he can tell you about. Why not call him today?

ARMSTRONG MACHINE WORKS
812 Maple Street • Three Rivers, Michigan

FACT-FULL LITERATURE FOR YOU

FREE: 44-Page Steam Trap Book plus two reprints explaining facts about trap operation on vacuum return service.

ARMSTRONG MACHINE WORKS
812 Maple Street, Three Rivers, Michigan
Please send Steam Trap Book, "Flash at Traps" and "Vacuum Isn't Vacuum."

Name_____

Company_____

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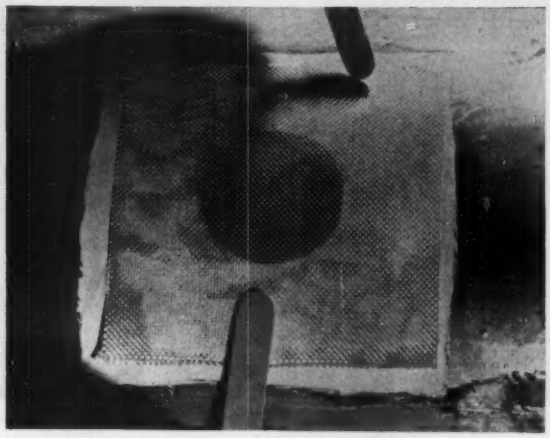
City_____ Zone___ State_____

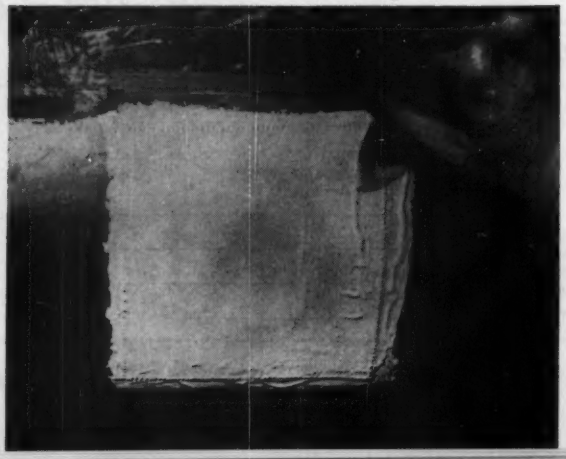
1 Thoroughly clean area to be patched



2 Prime, press on glass patch

3 Paint and press on second patch

4 Paint last patch and let dry



HOW TO

plastic patch metal

► Now, you can repair metal tanks, pipes and other containers of dangerous flammable materials without welding. Answer is epoxy-resin material and glass cloth. Such patches have been tested to over 1000 psi, according to manufacturer. Corroded or broken-out areas, split seams, breaks, and porous areas have been repaired in tanks, and in conduit handling gasoline, fuel and lube oils, acids, alkalies, and most liquid, gas or powdered materials.

Epoxy resin has great chemical stability and good adhesion to metals. It's oilproof and waterproof, resists acids and alkalies up to 200 F. It comes in white, known as *Sonite P-2*, and aluminum, known as *Sonite P-5*.

Repair kit has glass cloth, stirring paddles, brush and cleaner, and epoxy resin. First, clean area down to bare metal. Wash with brush cleaner to remove oil. When metal is dry, mix primer and paint onto area until tacky-hard. At 70 F, this takes half an hour. Then place glass-cloth patch in position and press into prime coat.

You can strengthen patch by painting and adding glass cloth. Job is neater if successive patches are cut slightly larger, thus feathering edges. File and sand the completed hardened patch if needed. Tank or pipe can be used 18 hours after hardening at room temperature. In cold weather, apply external heat to the patch for quick drying.

Courtesy, Smooth-On Manufacturing Company

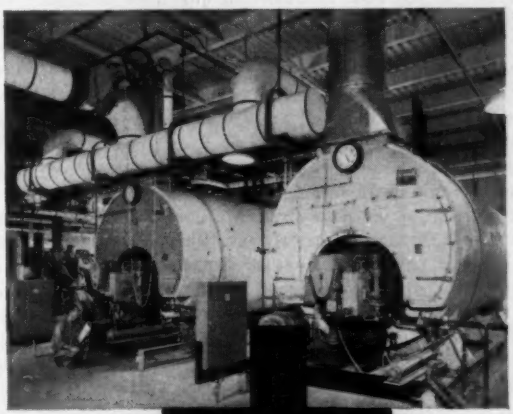
PACE-SETTER IN COMMUNICATIONS

CHOOSES "CRUISING SPEED" BOILERS

RCA Cherry Hill Project, Camden, N. J.
Archt—Vincent G. Kling, Philadelphia, Pa.
Engineer—Robert J. Sigel, Narberth, Pa.
Heating Contractor—Daniel J. Keating, Philadelphia, Pa.

Two "cruising speed" Kewanee Iron Fireman Boiler-Burner Units used for 'round the clock oil firing at RCA.

■ It's only natural an expert in one field would be satisfied with nothing less than a product manufactured by *experts*. And that's the reason Radio Corporation of America chose Kewanee Reserve Plus Rated Boilers for its new Cherry Hill project near Camden, N. J. Company officials wanted a boiler that met two specific requirements: (1) economical operation, (2) long life. They settled on Kewanee "cruising speed" Boilers with 50% extra built-in power. Like a smoothly-striding runner who holds back his final burst for the stretch drive, Kewanee's "cruising speed" boiler operation reserves its maximum power capacity until peak performance is demanded. Rated on nominal capacity, Kewanee Boilers give trouble-free performance with lower fuel and maintenance costs—higher efficiency and longer boiler life. Boilers rated on maximum capacity—those "going wide open" all the time—have no reserve, no "second wind," left for emergencies . . . are costly to operate and maintain . . . there's always the danger of mechanical failure caused by constant strain. So, just like RCA, make Kewanee Boilers *your* choice. Call the Kewanee man. He'll come sprinting to tell you about Kewanee's "cruising speed." KEWANEE BOILER DIVISION OF AMERICAN-STANDARD, 101 Franklin Street, Kewanee, Illinois.



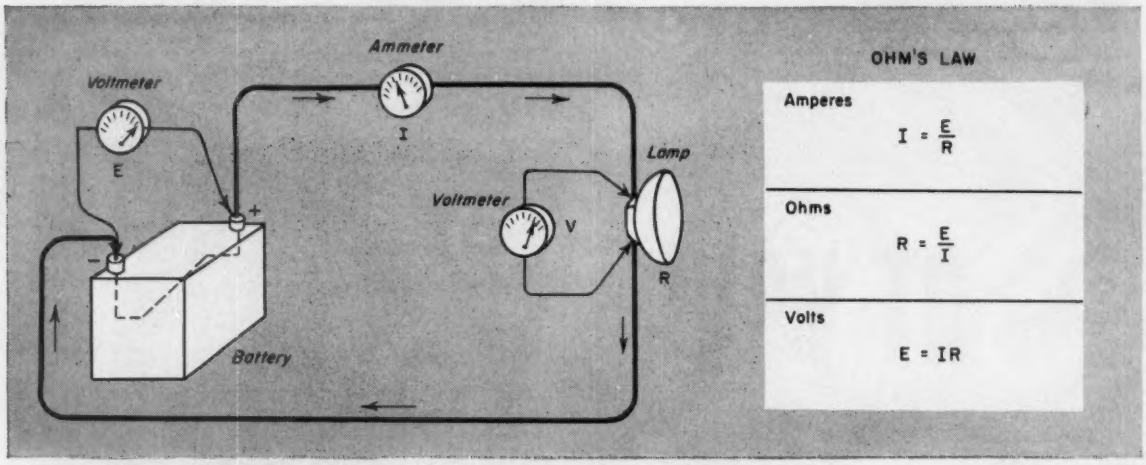
KEWANEE
reserve plus rated

KEWANEE BOILERS

DIVISION OF AMERICAN-Standard

BASICS . . . *bringing engineering theory down to earth*

NORMAN PEACH, *Assistant Editor*



ELECTRICITY: 2

Fundamental units and Ohm's law

► LAST MONTH we discussed how a stream of electrons makes an electric current. This was an "inside" view of electric current. Now let's take an "outside" look at electric circuits to see what fundamental quantities determine electric current. Electrons are too small to be practical units of current, so we use the *ampere* for measurements. A one-ampere current flows in a circuit when 6.28×10^{18} (or 6.28-billion billion) electrons pass a point in circuit every second. Actual standard ampere is steady dc current that deposits 0.001118 gram of silver from specially controlled solution in one second. Amperes may be compared to gallons per minute in liquid flow. Current is measured by an ammeter in *series* with circuit. Current flows through ammeter (or through ammeter shunt, which is outside of case).

Force is needed to move electrons and cause current to flow. This force is produced in many ways—by batteries, for example, or by generators—and is called *electromotive force* (emf). Unit of emf is the *volt*. Standard volt is 1/1.083 of emf produced by special-type electrochemical cell. In general, emf is the term used when speaking about a device that causes current to flow in circuit; *voltage* refers to electric pressure across *part* of circuit. Volts are measured by voltmeter in *parallel* with part of circuit.

Every circuit offers some opposition to current flow. This opposition is called *resistance* in steady dc circuits and some ac circuits (most lighting and heating circuits). For some materials, resistance is high, for others, very low. Resistance also varies with temperature. Resistance units are *ohms*. A circuit has a resistance of one ohm when an emf of one volt produces a current of one ampere in it. Sometimes it's desirable to put resistance in a circuit; devices intended for this purpose are called resistors.

Ohm's law relates current, voltage and resistance:

$$I = \frac{E}{R}, \quad R = \frac{E}{I} \quad \text{and} \quad E = IR$$

I is symbol for current in amperes, E is emf in volts, and R is resistance in ohms. When considering part of circuit, voltage V can be substituted for emf E.

Ohm's law shows us that voltage or emf equals product of current times resistance. Voltage, or emf, is "used up" around the circuit. If we remove voltmeter lead from – terminal of battery in sketch above, and move it along the wire, voltmeter reading will decrease until it is zero when both leads are on + battery terminal. Voltage decreases across a part of circuit in direct proportion to resistance of the part, causing *voltage drop*. Difference in voltage between beginning and end of a circuit element is known as *potential difference*. A potential difference is necessary to make current flow through circuit element. In sketch above, nearly all of circuit's resistance is in the lamp. Since wires are selected that have as little resistance as is practical, the IR drop in wires is small, and almost all the emf of the battery is across the lamp's terminals.

Ohm's law comes in handy for many practical calculations around the plant. If, for example, you wish to find out resistance of an unmarked resistor, it can often be found by ammeter-voltmeter method. Connect resistor to be tested in series with ammeter and emf (and usually a known resistor to limit current), and connect voltmeter in parallel with the resistor being tested. Insert the values of current and voltage indicated by the instruments into the Ohm's Law resistance formula and calculate the unknown resistance. *Next month, Basics turns its attention to Power and Energy.*

HERE you can make your selection of the BEST in MONOLITHIC REFRACTORIES

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Check the items on which you want information

☐ **H-W STANDARD CASTABLE—**
sets with a strong hydraulic bond, forming a monolith free from joints, used in arches, walls, hearths and doors. Its service limit is approximately 2400°F.

☐ **H-W EXTRA STRENGTH CASTABLE—**
has several times the mechanical strength of other castables and is especially suited for withstanding impact and abrasion. It is highly resistant to thermal shock, and in refractoriness corresponds to the H-W STANDARD CASTABLE.

☐ **H-W SUPER CASTABLE—**
serves under certain conditons where higher temperatures prevail—up to 2700-2800°F.

☐ **H-W HIGH-ALUMINA CASTABLE—**
is even more refractory than the H-W SUPER CASTABLE and may be used at temperatures up to 3000°F.

☐ **H-W CASTABLE-RC—**
is a refractory concrete which is used with good economy for intermediate duty service, such as paving around furnaces, low and intermediate temperature flues, hot floors and similar applications.

☐ **H-W BAFFLE MIX—**
is made with a coarse texture, which enhances its spalling resistance and other properties, especially desirable for use in monolithic baffles of boilers.

☐ **H-W 85 LIGHTWEIGHT CASTABLE—**
combines the properties of light weight and heat insulation for use at temperatures up to 2450°F.

☐ **H-W 56 LIGHTWEIGHT CASTABLE—**
weighs only 56 lbs. per cu. ft. Its thermal conductivity is about 38% that of high-duty fireclay brick. In the class of lightweight castables, it is unusually strong and volume-stable within its temperature limit of approximately 2100°F.

☐ **H-W CHROME CASTABLE—**
because of its density and chemical composition, is highly resistant to various corrosive fluxes and slags at high temperatures. An outstanding application is in bottoms and side walls of sodium salts recovery furnaces used in paper mills.

☐ **H-W STANDARD PLASTIC FIRE BRICK—**
is manufactured from the highest quality of hard calcined flint and plastic bond clays. It is equivalent to high duty fireclay brick in refractoriness and is used successfully under most conditions for which fireclay brick of this class are adequate.

☐ **H-W SUPER PLASTIC FIRE BRICK—**
is suitable for service requirements beyond the limits of standard plastic fire brick.

☐ **PLASTIC THERMOLITH BATCH—**
is a chrome refractory which is used to great advantage for the construction of furnace bottoms where the corrosive ash and alkaline fluxes is an important destructive factor.

OTHER TYPES: Among various specialized Harbison-Walker monolithic refractories is HARWACO MASTIC which is ideally suited for plastering with a trowel as for sealing V-shaped spaces at exterior faces of tubes of water wall boilers. Others include castables of low iron oxide content for particular catalytic requirements, and some having exceptional properties for certain exacting applications. These comprise ramming mixes in a wide range of chemical compositions.

Please check those of interest and write us for additional information

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"That evening we ended up at the Casa Suprema again. Only this time the boys wouldn't let me spend a cent."

Marmy's low vacuum

► THIS MORNING, for the first time in over four years, Marmaduke Surfaceblow paid us a surprise visit in our 26th-floor POWER office. We were assembling in Chief Editor Lou Rowley's office for our monthly schedule meeting when the cagey consulting engineer barged in.

"Mr Surfaceblow himself," greeted Lou in his cheerful way, extending a glad hand to our visitor. "What's the occasion for this pleasant surprise?"

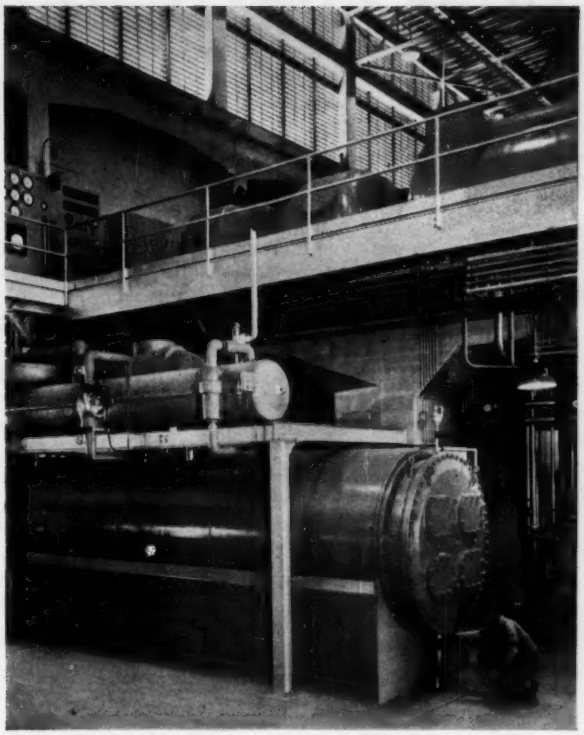
"Hello, Mr Surfaceblow," we all chimed in, crowding around the tall erect gent with the gray bowler perched at a rakish angle on his dome. But Marmy just grunted and walked over to the window. He hooked his thumbs into the armpits of his checkered vest and fixed his running lights on a ship headed up the Hudson River far below us. Then he grabbed a fistful of Webster cigars from Lou's desk, lit one of them from his own cigar butt and stuck the rest into his coat pocket. Next, he plopped down into a chair beside Lou's desk and started puffing away furiously, filling the room with smoke.

To break the ice, Lou said in his friendly way, "Here's a letter from an old engineer friend in Greensburg, Pa., Mr Surfaceblow. He writes, 'I visited a large industrial plant that has a low-level jet condenser, served by two single-stage ejectors. Valves of one ejector were easy to get to, so that stage was run all the time. Standby ejector's cut-off steam valve, which was out of reach, leaked steadily. This caused the diffuser to rust to a really sad finish. Then one day, Number One ejector gave up the ghost. But when the operator tried to switch to Number Two, it naturally wouldn't work. The jet manufacturer, who was near, came to the rescue. But I know that if Mr Surfaceblow had been there, he would have cleaned out the rusted diffuser, then opened the steam nozzle to compensate. By increasing both throat areas the same percentage, vacuum could again be established and the schedules met without delay. Of course, the moral is that standby equipment must be kept in order and steam fitters shouldn't hide valves beyond reach. Why don't you ask Mr Surfa. . . .'" But that's as far as Lou got.

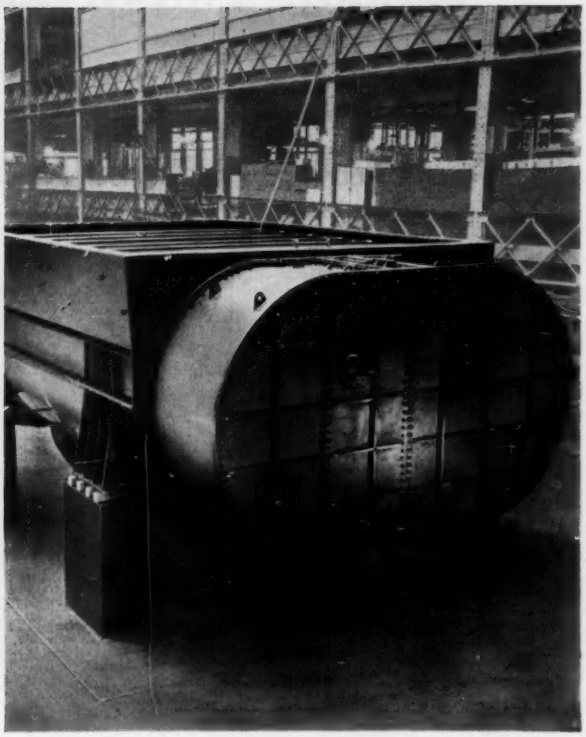
"Bilgewater on placing valves out of reach, on lazy operators and on raising vacuum," suddenly roared Marmy in his foghorn voice. "I'll tell you water logged editors about the time I found almost two inches of lost vacuum and all I did was cut out a boiler."

That did it. Lou quickly opened a window to relieve the smoke screen as well as the vibration on our ear drums. The rest of us found places to sit, for

(*Continued on page* 184)



One of 28 Worthington condensers serving 20,000 kw turbine generator units in a southern aluminum plant. Each unit has twin 9300 sq. ft. shells, tee-connected.



100,000 sq. ft. low-headroom oval-type Worthington condenser. One of five units serving 215,000 kw turbine generators at the largest power plant in Ohio.

Name the job... Name the space... WORTHINGTON has the condenser!

Worthington builds condensers in all sizes to meet any reasonable space requirement. A design exclusive... the Double Folded Tube Layer... enables Worthington to "tailor" a condenser to available space, reducing cost of foundation and building construction. Most headroom limitations are easily met. The Double Folded Tube Layer design is adaptable to almost any shape of condenser shell, without sacrificing efficient performance. Worthington offers a variety of arrangements including oval or rectangular single shell units, side mounted shells with exhaust elbow, twin shells with side or tee-piece exhaust connections, and special designs for "axial-flow" exhaust turbines. Worthington can meet your needs quickly and economically.

Contact your nearest Worthington District Office or write: Worthington Corporation, A&SP-Steam Power, Harrison, N. J.

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JENKINS PRACTICAL PIPING LAYOUTS 78

How to plan piping connections for an

ALL-YEAR SELF-CONTAINED AIR CONDITIONING UNIT

A factory-built "package", the modern self-contained air conditioning unit shown in this layout is designed for both summer cooling and winter heating. Installation of the unit is relatively simple. It is necessary only to supply steam or hot water to the heating coil, cooling water to the condenser, a condensate drain, and electric power for operation of the compressor. The required service connections are illustrated in the accompanying diagram.

The hookup for humidity control, particularly important for installations such as in night clubs, auditoriums, and others having a high moisture removal load, is also shown in the diagram.

In this particular system, is is assumed that steam is available for winter heating, and that the condenser is served by the city water supply. The condenser water discharge is used for the reheat necessary for humidity control.

During the winter season, the heat output is regulated by a modulating steam valve which operates in response to a room thermostat. In the summer, another room thermostat starts the compressor when cooling is required, and the two-position water control valve, located as shown in the diagram, permits the water to flow to the drain.

When dehumidification is required without cooling, a room humidistat keeps the compressor in operation, but changes the position of the two-position water control valve so that the condenser discharge flows to the heating coil.

Two water-regulating valves are employed as illustrated. One, in the city water line, is set in the usual manner to maintain a predetermined head pressure on the compressor by varying the amount of water flowing into the condenser. The second regulating valve, in the line from the condenser and to the heating coil, is set for a head pressure higher than the pressure on the feed control valve.

This secondary condenser water control reduces the cooling capacity of the unit and, at the same time, provides hotter water for reheat in the heating coil, thus serving to maintain proper relative humidity without excessive reduction of temperature. The amount of reheat obtained is approximately equal to the cooling provided by the unit, so that the net effect is that of dehumidification only, without cooling.

The Jenkins Fig. 106-A Bronze Globe Valves recommended for strainer blowoff and other services in this layout are the Renewable Composition Disc type. They provide dependable, vapor-tight closure, and every construction feature contributes to their reputation for lasting economy, low maintenance. Replacing the disc, at any time required, restores a Fig. 106-A to full efficiency, and the slip-on, stay-on disc holder design permits the change to be made quickly, without removing the valve from the line.

Consultation with accredited piping engineers and contractors is recommended when planning any piping system. To save time, to simplify planning, to get all the advantages of proved "extra value" design, specify Jenkins Valves for every service. Jenkins new Catalog No. 56 lists the full line. Jenkins Bros., 100 Park Ave., New York 17.

CALL YOUR NEARBY JENKINS VALVE DISTRIBUTOR

For any required information, and for prompt delivery of Jenkins Valves from stock, call your local Jenkins Distributor. Make full use of the many services of this qualified supply specialist. He can help you save time, simplify purchasing, and reduce operating costs.

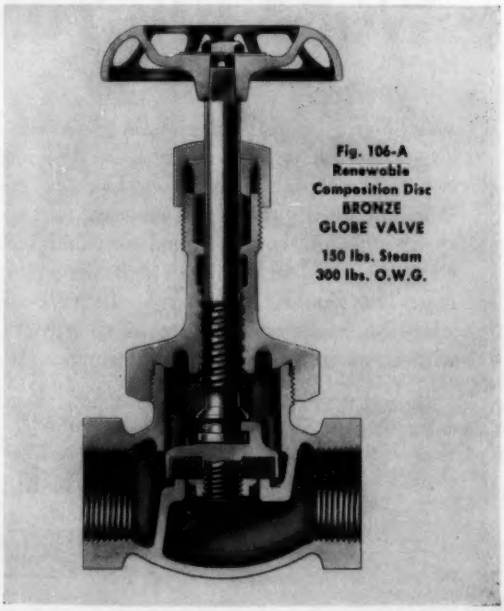


Fig. 106-A
Renewable
Composition Disc
BRONZE
GLOBE VALVE

150 lbs. Steam
300 lbs. O.W.G.

ALL-YEAR SELF-CONTAINED AIR CONDITIONING UNIT

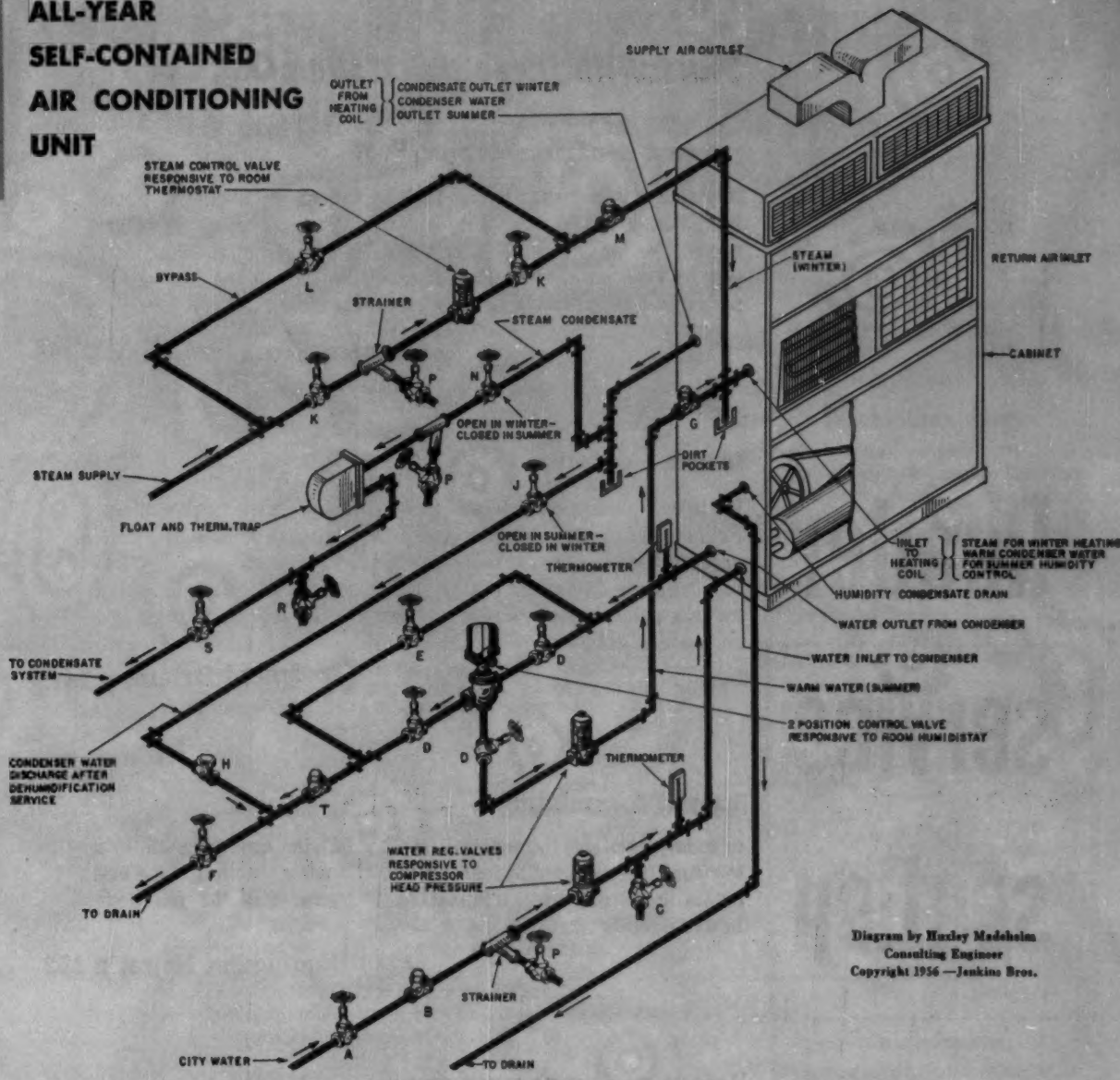


Diagram by Huxley Madeheim
Consulting Engineer
Copyright 1956 —Jenkins Bros.

VALVE RECOMMENDATIONS
For details of valves to suit varying conditions see Jenkins Catalog 56

Code	Qty.	Jenkins Valve	Service
A	1	Fig. 370 Br. Gate	City Water Shutoff
B	1	Fig. 92-A Br. Sw. Check	Prevent Contam. City Water
C	1	Fig. 106-A Br. Globe	Drain Water System
D	3	Fig. 370 Br. Gate	Shutoff Control Valve
E	1	Fig. 370 Br. Gate	Bypass Control Valve
F	1	Fig. 370 Br. Gate	Shutoff Drain Line
G	1	Fig. 92-A Br. Sw. Check	Prevent Stm. Flow To Water Line
H	1	Fig. 117-A Br. Lift Check	Prevent Backflow Thru Htg. Coil

Code	Qty.	Jenkins Valve	Service
J	1	Fig. 47-U Br. Gate	Prevent Stm. Flow To Drain
K	2	Fig. 370 Br. Gate	Shutoff Control Valve
L	1	Fig. 106-A Br. Globe	Bypass Control Valve
M	1	Fig. 92-A Br. Sw. Check	Prevent Water Flow To Stm. Line
N	1	Fig. 47-U Br. Gate	Shutoff Water To Cond. Syst.
P	4	Fig. 106-A Br. Globe	Strainer Blowoff
R	1	Fig. 106-A Br. Globe	Trap Test
S	1	Fig. 370 Br. Gate	Shutoff Condensate Flow

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
SINCE 1864
TRADE JENKINS MARK

SOLD THROUGH PLUMBING-HEATING AND INDUSTRIAL DISTRIBUTORS

Jenkins Bros

Reader service section

Start with these quick samples . . .

Largest dynamometer in West . . .

is the 10,000-hp hydraulic unit built by Enterprise Engine & Machinery Co. It weighs 90,000 lb, has a 9-ft diameter rotor. Principal use will be for testing company's new 7000-hp diesel engines. Good way to keep pace with developments like this in the fast-moving power field is to make a monthly habit of reading . . .

Reports From the Field, p 144

Major innovation . . .

in power production is the supercritical-pressure steam plant. Feature technical paper compares such an installation with a conventional steam plant, comes up with many noteworthy facts. Other recent papers on nuclear energy, lubricants, corrosion are abstracted for your quick review. And if you want the full reports, there's info on where to get them.

Technical Briefs, p 146

Special formulation . . .

of water, petroleum hydraulic oil and emulsifying agents results in a low-cost fire-resistant hydraulic fluid. "Snuffer" action is the key to its industrial use. Interested? You'll find the full dope in this month's . . .

Plant Equipment News, p 152

Before you make your move ...

check items 21 through 23 in this month's listing of manufacturers' bulletins. For convenience in obtaining any of the 40-odd items reviewed, use the handy post cards provided.

Free Literature, p 159

Building a better mousetrap?

Creative thinking teamed with curiosity should go a long way toward solving your problem. That's the sage advice handed out this month by our old engineer-philosopher . . .

George Edwards, p 162

For other timely ideas, see following service pages ▶

New Revolutionary Steam Trap

One large capacity seat for all pressures!

New Sarco Thermodynamic steam trap. Sizes ⅜ to 1"... each body as small as a tee fitting! Capacity is determined, not by a bulky body, but by the effective orifice, valve action, pressure drop and condensate temperature.

1. Cuts trap inventory

With the revolutionary Sarco TD steam trap, you use exactly the same trap... with exactly the same large capacity seat... for all pressures 10-600 psi... for heavy, light or no condensate load. Sizes ⅜ to 1".

2. All pressures 10 to even 600 psi!

...without changes or adjustments. Self-adjusting. High pressure construction... at a low pressure trap price!

3. Operates perfectly when pressure fluctuates

Absolutely no effect even from 600 to 10 psi! No water seal to evaporate. No adjustments.

4. Widest capacity range

Same large capacity seat for 10 as for 600 psi. Pressures of incoming air and condensate INSTANTLY AND FULLY raises valve head (disc), permitting maximum discharge.

5. Operates equally well on all loads

The same Sarco TD trap for heavy, light or no condensate load. No prime to lose. No adjustments.

6. No oversizing worries

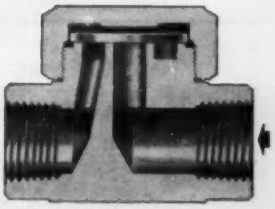
You can size the new Sarco TD steam trap for peak condensate loads... without risk of blowing steam on light loads... no prime to lose... no adjustments.

7. No steam leak required

...to operate the revolutionary Sarco TD steam trap (Pat. Pending). Closes tight against steam!

Convince yourself by 60-day trial... use coupon

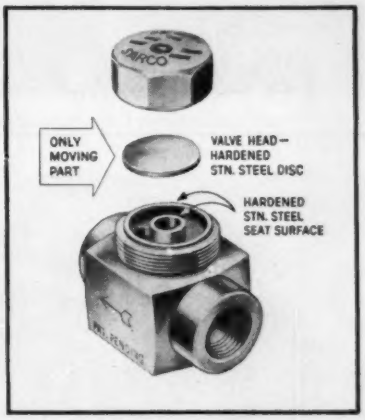
SARCO



Trouble-free design

Here is a trap so simple, it doesn't even have a valve closing mechanism. The kinetic energy of steam closes the valve. ONLY the new Sarco TD uses this operating principle.

No mechanism parts to wear or stick. No narrow channels to choke. No gaskets to leak.



Maintenance practically eliminated

The all-stainless steel Sarco TD has only 3 parts... cap, disc and body. Only moving part is a hardened SOLID stainless steel disc, practically wearproof.

SARCO COMPANY, INC.
Empire State Bldg., N. Y. 1, N. Y.

Please send me Sarco TD Steam Trap and strainer for 60-day trial.
Size_____ For use on_____

Name_____

Firm_____

Address_____

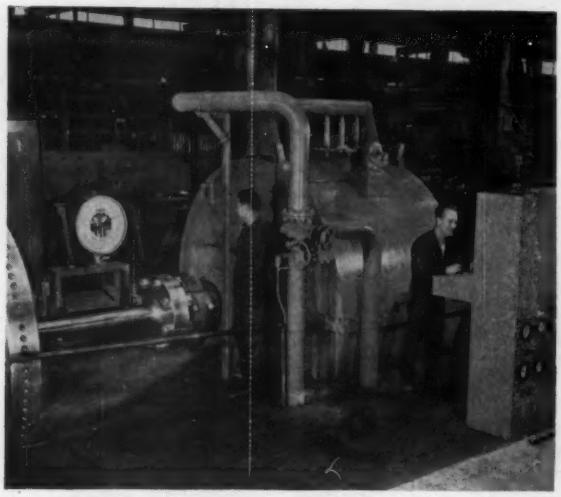
City_____ State_____

2161-B

REPORTS FROM THE FIELD

What's happening in power and what it means to you

For Calendar of Events see page 234



10,000-hp dynamometer to test diesel units

► WORKING FROM a 26-in. model, engineers at the Enterprise Engine and Machinery Co, San Francisco, have come up with the largest dynamometer in the West, to be used in testing the "diesel engine of tomorrow."

The $250,000 hydraulic unit, which has a capacity of 10,000 hp, weighs 90,000 lb and has a rotor 9 ft in diameter, took four months to build. It will be used to test the firm's new *RV series* diesel engines rated at more than 7000 hp.

Vertical sliding weir gates, rather than conventional valves, control hydraulic load. This system keeps hydraulic load constant even if there are pressure surges in water supply.

Because job was on a one-shot basis, casting was considered uneconomic and parts were welded together.

Pit for dynamometer is 76x22 ft and provides room for a test stand at each end of the giant unit. One engine can be placed while the other is undergoing the test. Design permits rotation in either direction.

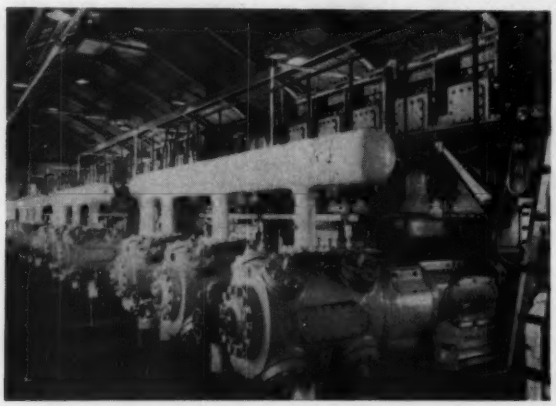
Boxcar houses naval compressed-air plant

► THE BOXCAR, pictured opposite, is actually a complete compressed-air plant capable of producing 5000 cfm of air at 100 psi, ready to go on a moment's notice in a military or civilian emergency.

The 11th Naval District, with headquarters at San Diego, Calif., keeps the boxcar, which will be on tap if needed, to keep essential air services going. The unit is said to have a wide range of possible uses.

Output is greater than the compressed-air capacity of many large factories. It's supplied by two 3-stage compressors of 2500-cfm capacity each, complete with intercoolers, aftercoolers and receiver.

Custodian of the emergency air supply is the Naval Repair Facility at San Diego.



To use new compressor for gas pipeline

► A SUPERCHARGED angle gas-engine compressor, representing the first of its kind in gas pipeline service, will be installed at El Paso Natural Gas Company's Navajo Compressor station.

The engine, a Worthington SUTC-1610, accompanied by four UTC-1610, 2000-hp units, will be situated at an altitude of 6500 ft. The increased altitude will necessitate a decrease in the sea-level rating of these engines. The four 2000-hp units will be rated at 1600 hp at the site. The supercharged 2500-hp engine will be derated to 83% of sea-level rating.

The Navajo station is on the main transmission line which extends almost directly west to San Francisco.

(*More Reports From the Field on page* 232)

Unloading 1200-TON BARGES

in less than 90 minutes

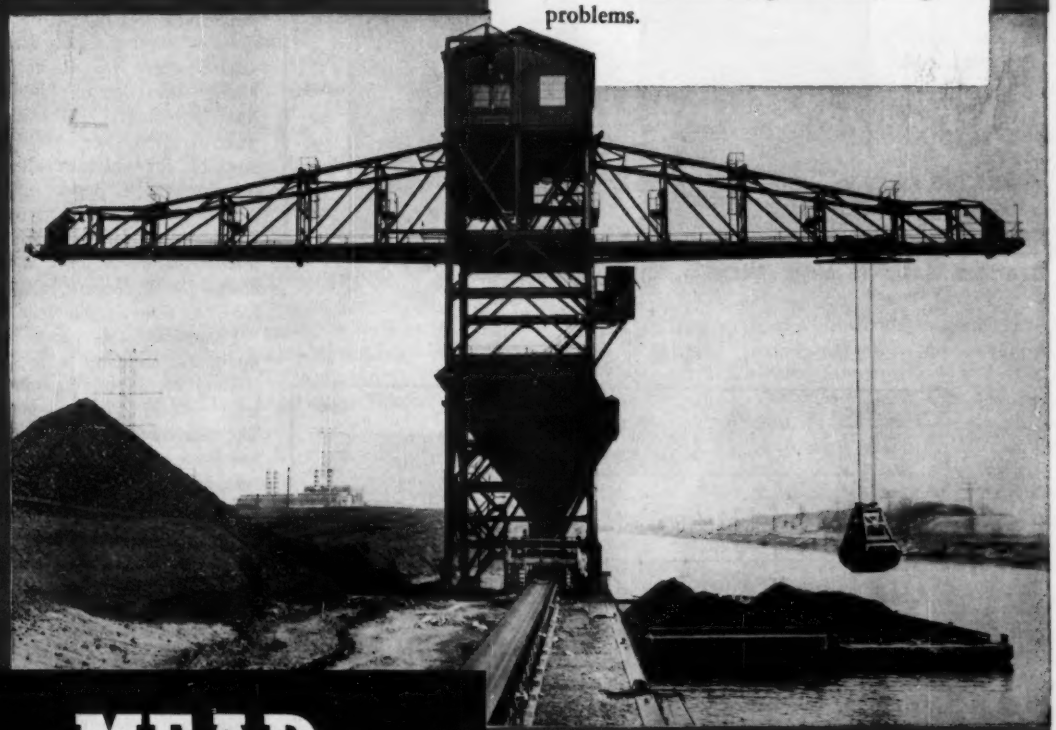
(including clean-up)

This new Mead-Morrison 10-ton stationary coal tower, recently installed at Commonwealth Edison Company's Ridgeland Station, was designed for a free digging rate in excess of 1200 tons per hour from barge to hopper.

The use of a Mead-Morrison lightweight coal grab and a Mead-Morrison barge haul system contributes to this outstanding performance.

One of the features of this machine is an extended cantilever at the rear, allowing coal to be put in storage and to be reclaimed from storage to conveyer belt or barge. Power to the hoist drums is supplied by wound-rotor motors and counter-torque, full-magnetic, reversing, alternating current control for 4160 volts.

Mead-Morrison Coal and Ore Handling Bridges and Unloading Towers are available in capacities up to 2000 tons per hour. They have proven their efficiency and dependability for over 50 years in installations all over the world. Be sure to consult Mead-Morrison on your material unloading and rehandling problems.



MEAD-MORRISON

Division of

McKIERNAN-TERRY CORPORATION

manufacturing engineers

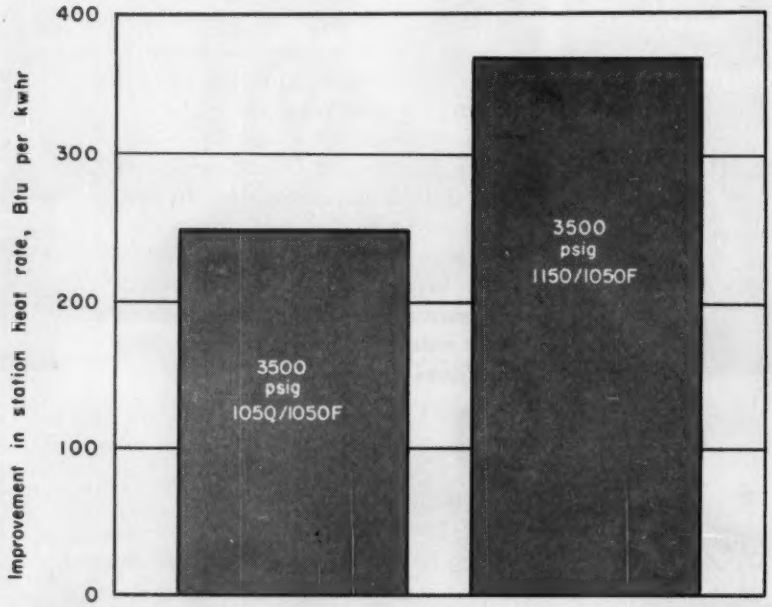
HARRISON, N. J.

TECHNICAL BRIEFS

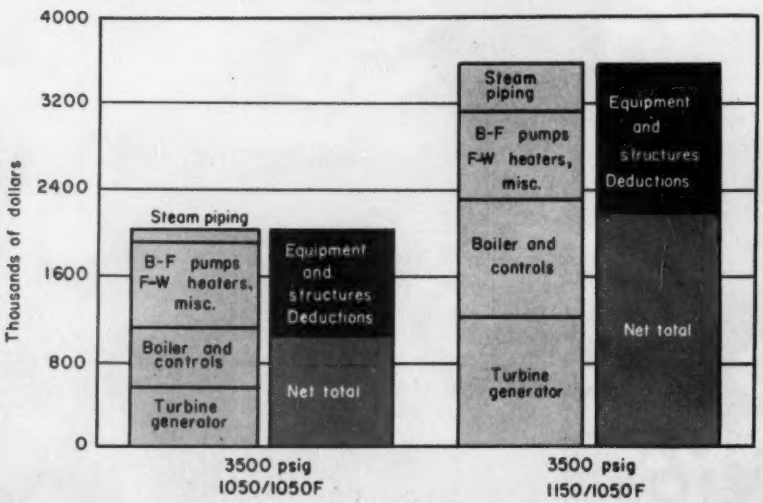
Latest engineering developments for busy power men

25 Papers for you on
STEAM TURBINES
NUCLEAR ENERGY
LUBRICANTS
CORROSION

Economic evaluation of large supercritical-pressure steam-power-plant cycles



STATION HEAT-RATE IMPROVEMENT—typical 3500-psig cycles over 2400-psig cycle



INCREMENTAL INVESTMENTS—typical 3500-psig cycles vs 2400-psig 1050/1000-F

A comparative study of a large steam turbine application for supercritical and conventional pressures. *By J J Fleischmann, A H Gibeling, A Mergy and E R Miller, Allis-Chalmers Manufacturing Co.*

The supercritical - pressure steam plant represents a major innovation in power production. It is logical that advantages and disadvantages of the supercritical-pressure plant should be determined by comparison with a conventional-pressure steam plant which is a known quantity. This paper presents such a comparison for a specific application, using a 2400-psig 1050/1000-F plant as a base with which to compare two supercritical - pressure plants.

A design for a turbine operating at 3500-psig 1150-F inlet conditions is presented. Design and operational features of other components of a supercritical cycle are discussed. An economic evaluation of the estimated station incremental costs and heat-rate gains is given. See charts, *left*, and on page 148 for typical results of the study in paper. *APC paper; no number.*

Predicting performance of large steam turbine-generator units for central stations. *By H Hegetschweiler and R L Bartlett, General Electric Co.*

Purpose of this paper is to provide the power industry with an up-to-date method for predicting performance of large steam turbine-generator units. The efficiency calculation method given has been adjusted carefully to show a true comparison between machines of different types, sizes, steam conditions, reheat and non-reheat, etc.

The level of performance obtained by use of this method is judged to be the highest justifiable for prediction purposes at the present state of the art. Based upon the performance calculation method presented in this paper, relative heat-rate curves have been prepared comparing the performance of various turbine-generator units at normal nameplate rating. A complete heat-balance diagram and an efficiency calculation example are included illustrating the use of the method. *ASME paper No. 50-SA-52.*

More Technical Briefs turn page

Johns-Manville organizes to give you better insulation service

New and separate insulations division created to provide industry greatly improved Sales and Engineering service to meet modern problems

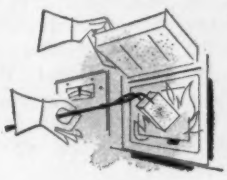
• Johns-Manville is now concentrating all industrial insulation operations within a new, fully integrated insulations division. This greater specialization makes possible the most complete insulation service available to industry. It consists of—

Sales Representatives . . . men on whom you can rely for your insulation recommendations. Your J-M salesman will help you select the insulating material exactly right for your job—the one that will provide maximum fuel savings, improved process control, and minimum maintenance. As co-ordinator of J-M's extensive research-engineering-manufacturing facilities, he offers you outstanding insulation training and experience.

Insulation Engineers—Backing up the J-M salesman on every job is the J-M insulation engineer. He is primarily concerned with solving insulation problems. He recommends the economic thickness of insulation, as well as the proper finishes, weatherproofing and securement. His highly specialized knowledge makes possible an intelligent recognition and handling of your individual insulation requirements.

Insulation Contract Units . . . Fully aware that no insulation is better than the man who applies it, the J-M Insulation Contractor makes care and skill in the scientific application of Johns-Manville insulations his stock in trade. He maintains a complete crew of estimators and mechanics trained in J-M application techniques. He is ready to give you fast, efficient service on any insulation job—large or small. Proud of his reputation for integrity in his own community, the J-M Insulation Contractor merits your complete confidence.

Complete Range of Products—In this day of exacting temperature control, the need for specific insulations for specific services is greater than ever before. Recognizing this, Johns-Manville manufactures insulations for every industrial requirement. Produced from the finest grades of asbestos, magnesium carbonate, diatomaceous silica, refractory clays and ceramic fibers, they are designed to afford maximum insulating effectiveness and durability at operating temperatures ranging from minus 300F to plus 3000F.



Extensive Research Facilities—At Manville, New Jersey, Johns-Manville maintains the world's most completely equipped insulation laboratory. Here insulation scientists are engaged in a continuous program of developing new and better insulating materials. In addition, their technical knowledge is always available to J-M customers whose insulation problems require special study.

Experienced Management—At headquarters as well as in the field, management of the new insulations division consists of men who, in line with J-M's promotion-from-within policy, are insulation veterans. With a realistic grasp of customers' needs, they are alert to new and better ways to serve you . . . now, and in the future.

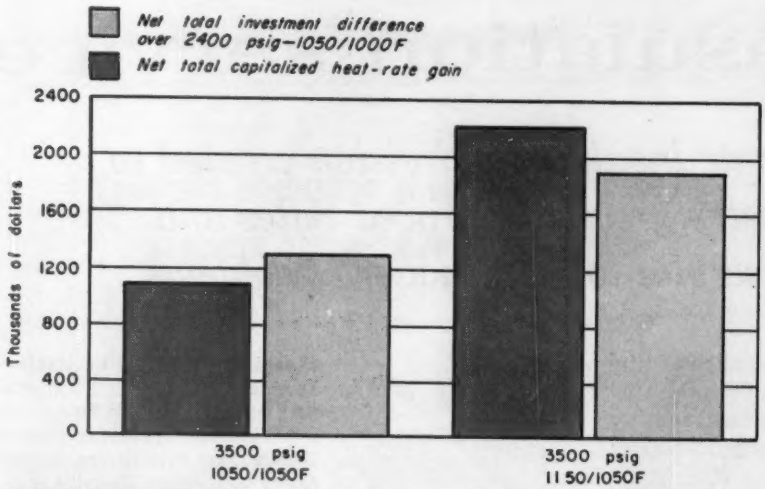
On Your Next Insulation Job—Whether your next insulation job is big or little, simple or complex, let Johns-Manville handle it for you. Just call your nearest J-M sales office, or write direct to Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario. *Chances are, you'll be glad you did!*

Johns-Manville *first-in* INSULATION

MATERIALS · ENGINEERING · APPLICATION

More TECHNICAL BRIEFS

Begins on page 146



INVESTMENT SUMMATION and capitalized heat-rate for the plants studied here

A planned turbine testing program. *By F H Light, Philadelphia Electric Co.*

A planned turbine testing program provides an effective means of detecting economy losses due to turbine performance and provides data to evaluate the reason for the loss. Corrective measures such as turbine washing or turbine maintenance can often restore the turbine to normal efficiency, and if these measures can be justified by test results, prompt action can prevent large fuel losses which would ordinarily go undetected.

A well-planned program that provides proper turbine instrumentation located conveniently so that a few observers can perform the periodic turbine tests will require only a few man hours per month to obtain and compute the test results. This expenditure for instruments and time is well justified, on the basis of experience, by the operating savings effected.

The planned turbine testing program has four phases: (1) planning and selection of turbine instrumentation (2) development of turbine test correction factors (3) a planned turbine test procedure and method of calculating test results (4) interpretation of the test results. These are discussed in the paper. *ASME paper No. 55-A-53.*

Turbine supervisory instruments. *By J C Spahr and R L Richards, Westinghouse Electric Corp.*

The operation and function of a complement of current turbine supervisory instruments are described. The instruments are shaft-eccentricity meter, cylinder-expansion meter, differential-expansion meter, flange differential-temperature meter, shaft-position meter with a hydraulic backup device, thrust meter, and shaft-vibration meter. Charts showing typical operating events are discussed. The present and future philosophies concerning the use of supervisory instruments are given in the conclusions. *ASME paper No. 55-A-62.*

Instrumentation for steam consumption tests on medium steam turbine-generator sets. *By D E Kimball, General Electric Co.*

In a 1954 paper the author presented various measures of the uncertainties of the data of precision steam-consumption tests on medium-sized steam turbine-generator sets, deriving them from the overall results of the tests and from comparisons of duplicate instruments used in them. In the present paper he briefly describes the instruments and their calibrations and presents typical calibration corrections. The instruments and their calibrations have been used for many years.

Most comparisons presented here demonstrate that instruments of high precision have small calibration corrections which are significant and that most corrections do not change significantly. They also show that these instruments can be relied upon in very precise turbine steam-consumption tests. *ASME paper No. 55-A-206.*

Directions for ordering papers on p 224

Nuclear energy

A digital computer program for determining atomic wave functions. *By W W Piper, General Electric Co.*

Solution of a set of second-order differential equations for computing Hartree-Fock self-consistent field wave functions has been successfully programmed for use on an *IBM type 650* magnetic-drum digital computer. These equations are nonhomogeneous and have coefficients which are functions of the solution. Thus, the equations must be integrated a sufficient number of times to reach a state of self-consistency. For a particular atomic configuration this may be accomplished in five to eight hours of machine time with the present program. This represents a tremendous saving over previous hand methods. *AIEE paper No. 56-155.*

Power reactor development program in the Netherlands. *By Dr J J Went, Kema Research Laboratories, Arnhem, Netherlands.*

Economic, technical and safety problems are playing a decisive role in the development of power reactors. It is probable that the power reactor types under construction at the moment will be different from the systems to be used in future. Evidently the construction of real power reactors, with the present status of technological knowledge, must be conservative. It is quite obvious that a long-term power-reactor development program will be different from a short-term program.

In the Netherlands it is believed that the economic potentialities of nuclear reactors are so important, that the choice of advanced types, even if that will result in a long-term program, is justified. *WPC paper No. 201 J/14.*

The technical problems of designing and operating reactors for producing electrical power and the problems of making them economic. *By H H Gott, Atomic Energy Industrial Group, United Kingdom Atomic Energy Authority.*

This paper reviews the various types of reactors which are potentially available for power production. It is emphasized that this is already a large-scale industrial and economic problem and plants which do not have the backing of extensive allied engineering experience are at a disadvantage.

In a fully developed power system involving a large number of units the

(*Continued on page* 150)

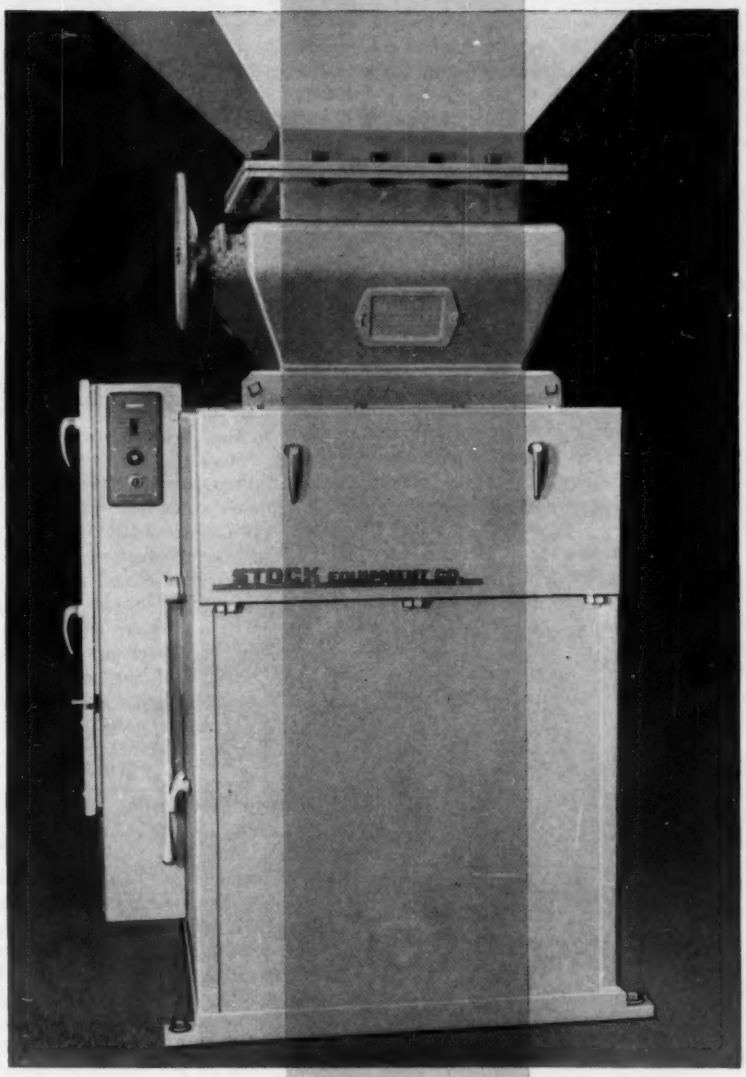
THE NEW S-E-CO. MODEL 50

COAL SCALE is the only scale that carries a 24" width of coal through the scale without restriction

To meet the requirements of central stations and industrial plants that are using larger and larger boilers — and to move coal that is becoming more and more sluggish — Stock Equipment Company has developed their new Model 50 Automatic Dust-Tight Coal Scale.

The inlet is a full 24" inside square and the feed belt carries the coal straight through in an unrestricted 24" stream. The belt has the well known S-E-Co. endless, molded construction and is carried on closely spaced anti-friction idlers. This design allows it to handle the inlet loading (even under the largest bunkers) without danger of belt failure or shortened life.

The Model 50 includes many other new and advantageous features. Contact the Main Office in Cleveland or any of the local representatives to arrange for a conference to discuss these features in detail. Your next unit, whether it's brand new or part of a rebuilding program, deserves and needs the new S-E-Co. Model 50.



SPECIALISTS IN
BUNKER TO PULVERIZER AND
BUNKER TO STOKER EQUIPMENT

STOCK Equipment Company

745-P HANNA BLDG., CLEVELAND 15, OHIO

More TECHNICAL BRIEFS

Begins on page 146

writer wishes to see the parallel operation of gas-cooled thermal reactors and sodium-cooled fast reactors. The gas-cooled reactor produces electricity competitively without need for enriched uranium fuel or any other isotope separation plant; moreover it is inherently safe, perhaps the only reactor whose safety can be relied on under any foreseeable circumstances.

The high concentration of fissle material in the fast reactor implies a need for a very high-heat release. As this may be difficult to achieve for a core with a very high gain factor, a compromise must be expected. Mention is made of the operation of reactors and the possibility of carrying out maintenance work on them. *WPC paper No. 175 J/12.*

Atomic energy progress in Sweden 1945-1955. *By Harry Brynielsson, Managing Director of the Swedish Atomic Energy Company.*

Sweden has no coal or oil deposits worth mentioning but in her alum shale deposits she has an abundant but low-grade raw material for uranium. Atomic energy therefore must be of great interest for the future energy supply of the country.

Atomic energy work is divided between two organizations, the Atomic Energy Commission and the Atomic Energy Company. The Commission, appointed in 1945, acts as an advisor to the Government and also as a research council supporting the fundamental research.

The Atomic Energy Company was founded in 1947 to take care of the applied research and industrial problems in connection with the atomic energy program—to prospect for and manufacture materials necessary for atomic energy production, to construct and build reactors, and to handle industrial and commercial matters. It is jointly owned by the State and some private industries.

Since 1953 the Company has had a uranium extraction plant running in Kvarntorp, using as raw material alum shale with an uranium content of about 200 grams per metric ton. The concentrate is purified in a chemical plant in Stockholm where also the uranium metal is fabricated.

In July, 1954, the Company started the first Swedish experimental reactor R 1 in an underground laboratory in Stockholm. This reactor provides information about the running of reactors and the arrangements for regulation, control and measurement, protection against radiation, etc.

As the next step there are plans to build a development reactor with the highest possible neutron flux and with facilities for carrying out experiments at high temperatures. For this reactor and future experimental work in the reactor field, the Company has acquired an area of about 150 hectares (300 acres) at Studsvik, about 80 kilometres south of Stockholm. *WPC paper No. 128 J/4.*

Test of a once-through steam generator with a liquid metal as a heat source. *By J J Morabito and R H Shannon, Atomic Power Development Associates, Inc.*

The paper covers basic concepts and factors involved in the design and testing of a once-through steam generator using a liquid metal as a heat source. Primary purpose of the test is to prove the feasibility of this type of unit for use in a nuclear power plant.

Most of the nuclear reactors in operation, and those currently proposed, are of the liquid-cooled type. The once-through type unit is particularly adaptable in the generation of steam utilizing heat energy from a nuclear reactor with a liquid coolant for the following reasons: (1) A simple counterflow, shell-and-tube heat-exchanger design results in considerably lower installed can be used (2) Inherent compactness cost than for other types of units. *ASME paper No. 55-A-189.*

The Westinghouse Testing Reactor. *By E T Morris, Westinghouse Electric Corp.*

The Westinghouse Testing Reactor when placed in operation during midsummer 1957, will provide a versatile facility for irradiation experiments within the range of 6.4×10^{12} to 7×10^{13} n/cm^2/sec. The power output of the reactor will be a maximum of 20 megawatts with 85-F secondary cooling water. A total of 2600 linear inches of various diameter space plus an 8-in. diameter beam hole will be available.

The reactor will be built about in the center of a 750-acre tract of land located 29 miles southeast of Pittsburgh in Westmoreland County, Pa. This site was selected after a careful survey of the area within a 40-mile radius east and south of Pittsburgh. The tract, consisting of a large level area protected on the west, north, and east by hills rising about 150 ft, is conveniently adjacent to satisfactory sources of potable water, natural gas, and electric power as well as a railroad and a large creek. The local area is rural, devoted to farming and dairying, with a population of only 2000 within a 2-mile radius, although there is a population of 300,000 within a 15-mile radius. *APC paper; no number.*

Directions for ordering papers on p 224

Lubricants

Fire resistant turbine fluids: a progress report. *By James J O'Connor, Managing Editor,* POWER *Magazine, McGraw-Hill Publishing Co, Inc.*

For many years power men have been making sporadic attempts at finding a turbine lubricant that is really fire resistant. Over a year ago interest in this subject was revived when a few chemical manufacturers and one major oil company indicated some present materials showed distinct promise.

Bench tests were run, followed by field tests in turbine-driven boiler feed pumps. Results to date look good with some reservations. Apparently there is little worry about the fire-resistant or lubricating qualities of the material being tested, a phosphate ester fluid. But there is definite study being given to combating foaming in service and the possible harmful effect of such fluids on generator insulation.

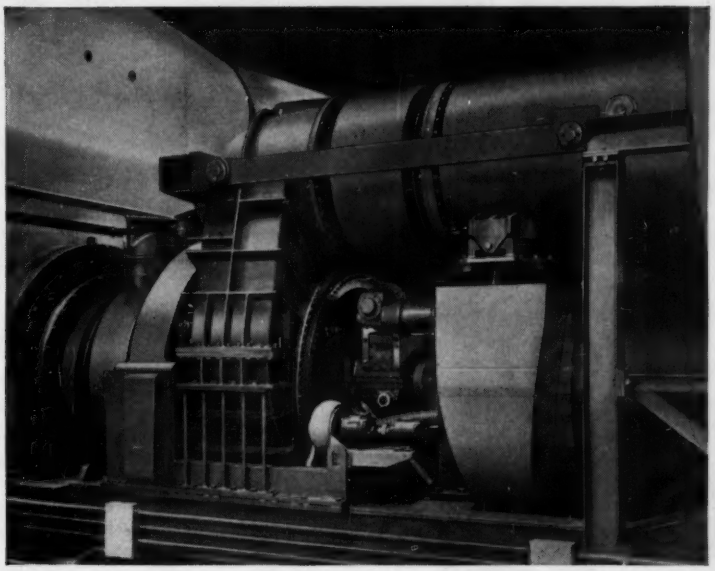
To date there have been run, or are now running, four separate field tests on the fluid: A boiler feed pump at Waterside station of Consolidated Edison in NYC has had a trial run with Socony-Mobil's *RL 265A*; the same unit is now operating with a phosphate ester base fluid developed by the Celanese Corp and labeled *Blend 998A.* A boiler feed pump at the Phillips Station of Duquesne Light Co has been operating since May 27, 1955 with a phosphate ester fluid produced by Monsanto Chemical Co and tagged as *OS-58-1.*

The first installation of a synthetic fire-resistant lubricant in the main bearing system of an operating turbine generator was recently made in a 35,000-kw unit in the Northwest Station of Commonwealth Edison Co in Chicago. The fluid used here is Socony-Mobil's *RL-265A. ASLE paper; no number.*

Electron diffraction in lubrication research. *By Douglas Godfrey, California Research Corp.*

Electron diffraction is extremely useful in revealing information about the

(*Continued on page* 218)



Clark 8500 BHP Gas Turbine for centrifugal compressor, generator or pump drive.

GAS TURBINES + CENTRIFUGAL COMPRESSORS

Only CLARK builds both!

Now you can get centrifugal compressors and modern gas turbines to drive them *exclusively* from one manufacturer . . . Clark.

In addition to saving money and headaches, you'll get proved, matched-performance "packages" specifically designed for continuous trouble free service.

Whether you have a million or a billion cubic feet of air or gas per day to handle at pressures of up to 4500 pounds per square inch, there is a Clark centrifugal compressor and in most cases a matching Clark gas turbine to drive it.

Your nearest Clark representative will be pleased to give you all the facts.

CLARK BROS. CO., OLEAN, N. Y.

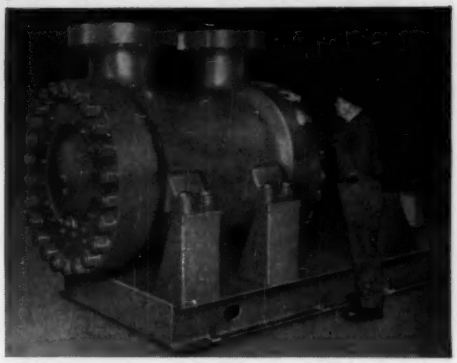
One of the Dresser Industries

Offices in Principal Cities throughout the World

CLARK®

GAS TURBINES
CENTRIFUGAL COMPRESSORS

Clark Barrel Type Centrifugal Compressors for extremely high pressures.



Clark Multi-Stage Centrifugal Compressors designed for process applications.

Clark Centrifugal Pipeline Booster for low ratios and high pressures.

PLANT EQUIPMENT NEWS

Your information center for new products designed to solve plant problems

Published monthly as a service to readers

Petroleum-water offered as fire-resistant hydraulic fluid

901 • *Irus Fluid 902* is a "snuffer" type hydraulic fluid whose fire-resistant qualities prevent it from burning on contact with flames, heated metal surfaces or molten metal. A formulation of water, petroleum hydraulic oil and emulsifying agents, the fluid is for use where hydraulic leaks or line ruptures would be fire or explosion hazards.

The fluid eliminates possibility of combustion by releasing its water content as a protective steam blanket to quench fire. This "snuffer" action reduces local temperature and displaces oxygen from the immediate area; in most cases the remainder of the hydraulic fluid will not support its own combustion. A further advantage is that the oil will continue hydraulic action should the water be dissipated for any reason.

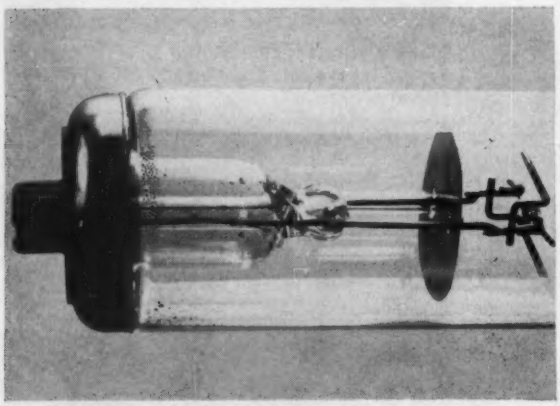
Subjected to the pressure-ignition spray test, photo left, the fluid was forced through a 0.0145-in. diameter sharp-edged orifice at 1000 psi and 60 to 100 F. With an oxyacetylene torch adjusted for neutral flame, an attempt was made to ignite the fluid stream at distances up to 18 in. from the orifice. Under these conditions, it was impossible to ignite the fluid, according to the manufacturer's report.

Despite water in its composition the fluid is claimed to have the petroleum hydraulic oil characteristics vital to proper functioning of hydraulically-operated machinery. It is non-corrosive on ferrous and most non-ferrous metals and is colored a bright yellow to permit recognition and location of possible leaks.

Irus Fluid 902, according to Shell engineers, can be used in place of any conventional mineral or synthetic oil hydraulic system. It can be installed without modification of lines, pumps, valves or cylinders. The fluid will not affect packing materials, seals or hoses and can be used in most industrial vane and gear pumps, according to the manufacturer. Cost is $1.25 gallon with certain delivery and zone differentials.

Shell Oil Co, 50 W 50th St, New York 22, N. Y.

For more data on these items, use post cards on page 159. Identify your request with item number.



Fluorescent lamp boasts high output

902 • Standard-size fluorescent lamp provides 2½ times as much light as conventional models and is universal in application, according to manufacturer. Heart of the lamp is the cathode assembly, photo, Black bubbles at lamp's base are condensed mercury in the pressure control center.

Four features claimed by manufacturer are: (1) more efficient lamp diameter (2) rapid-start continuous filament heating (3) pressure control center (4) use of neon gas instead of argon.

First two models in the line are a 100-watt four-foot unit rated at 6200 lumens and a 200-watt eight-foot model of 13,250 lumens. They are applicable to both indoor and outdoor service. Request further data from manufacturer.

Sylvania Electric Products Inc, New York 19, N. Y.

For more product developments in the electrical field, turn page ►

This Crane valve on superheated steam since 1946—with no maintenance

You'll spot cost-saving performance in the record behind this Crane valve—it has been on duty an even decade of years, with no maintenance at all!

Neches Butane Products Company installed this Crane 8-inch, 900-pound Pressure-Seal angle stop-check valve in 1946 in its butadiene plant in Texas. On superheated steam boiler service, this valve has never failed to close tightly and surely—and operate smoothly and easily—with no sticking, no troubles—no need to go near it with a wrench.

There's no question that dependability is a must in service like this. Minimum restriction of steam flow—plus smooth, positive and quick seating on backflow—*must* be provided for safe, steady boiler operation. And Crane stop-check valves can do it—*have* been doing it for years and years.

Before you specify any valve, be sure to look into the advanced designs and materials, the broad selectivity and service suitability of the great Crane line. You'll find everything you need in valves and fittings—built to the highest standards of quality. Get full information from your local Crane Representative, or write to address below.

CRANE VALVES & FITTINGS

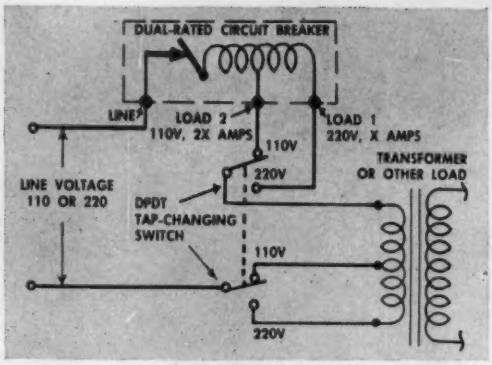
PIPE • KITCHENS • PLUMBING • HEATING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

More EQUIPMENT NEWS

Begins on page 152

Three recent electrical developments

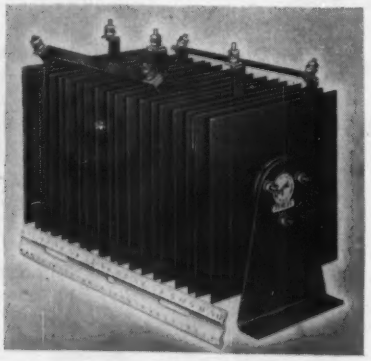


Circuit breaker protects dual-voltage equipment

903 • Dual-rated circuit breaker protects equipment designed to operate on either of two different voltages—such as 6 and 12-volts dc or 110 and 220-volts ac. The breakers have two ratings; for example, 2 and 4 amp or 5 and 10 amp with separate load connections for each rating. Although most ratings supplied to date have had current ratios of 2 to 1, breakers with current ratios of up to 4 to 1 can be supplied. Minimum and maximum ratings are 1 and 40 amp respectively. Diagram, above, shows a unit being used to protect a transformer capable of operating on either of two voltages.

Because of its hydraulic-magnetic operation the circuit breaker ratings are unaffected by ambient temperature. Dual-rated units have one of three inverse time-delay characteristics or are in instantaneous-trip form. Maximum voltage is 480 ac, 125 dc. Request bulletin 3430 from the manufacturer.

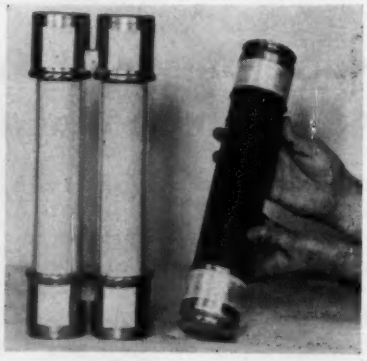
Heinemann Electric Co, 710 Plum St, Trenton 2, N. J.



High-power silicon rectifier

904 • Unit weighs 5 lb, occupies ¼ cu ft, and is rated at 100 amp, 200 v. It will rectify 20-kw of ac power with an efficiency exceeding 98 percent, according to manufacturer. The rectifier is particularly suitable for battery charging, etc where high-power dc requirements exist and only ac sources are available. A transformer-rectifier using these units reportedly converts 440-v 60-cycle power into both 120 and 240-v dc power.

Bogue Electric Manufacturing Co, 52 Iowa Ave, Paterson 3, N. J.



Current-limiting fuse

905 • Ribbon-element current-limiting fuse, photo, right, supersedes the wire-element fuse shown in photo at left. Designed for use with motor starting equipment, it consists of silver elements surrounded by dry inorganic quartz sand. It is enclosed in an insulating tube and connected to the circuit by copper ferrules on each end of the tube. A higher continuous current rating is one of claimed features. Request details from manufacturer.

General Electric Company, Schenectady 5, N. Y.

One-piece pressure seal

906 • This new sealing device is said to be particularly adaptable to sealing under bolt heads, abutment flanges such as pipe unions, or similar flanges which require sealing between two faces with the bore open to pressure.

The seal consists of an inner sealing member made of *Hycar* rubber, heat and pressure bonded to an outer confining steel ring or washer. The device supplies a positive lock-washer action and effectively seals pressures up to 10,000 psi against air, water, all types of petroleum products, and many industrial gases and chemicals. The seals function in a temperature service range from –65 to 250 F. A high-tensile cold-rolled steel is used for the washer and is cadmium-plated to prevent corrosion.

When compressed the resilient sealing lips of the *Hycar* member form a convex surface opposing the steady or pulsating pressure—giving the positive seal. Sizes range from ⅛ to 1¼ in.

B F Goodrich Chemical Co, 324 Rose Bldg, Cleveland 15, Ohio

Steam-assist desuperheater

907 • Unit meets all specifications for a conventional steam-atomizing desuperheater, and normally uses assisting steam on light loads where control is most difficult, according to manufacturer.

A stainless steel swirl chamber that has no moving parts automatically reduces flow of assisting steam as load increases and shuts off completely at high loads where mechanical atomization alone is effective.

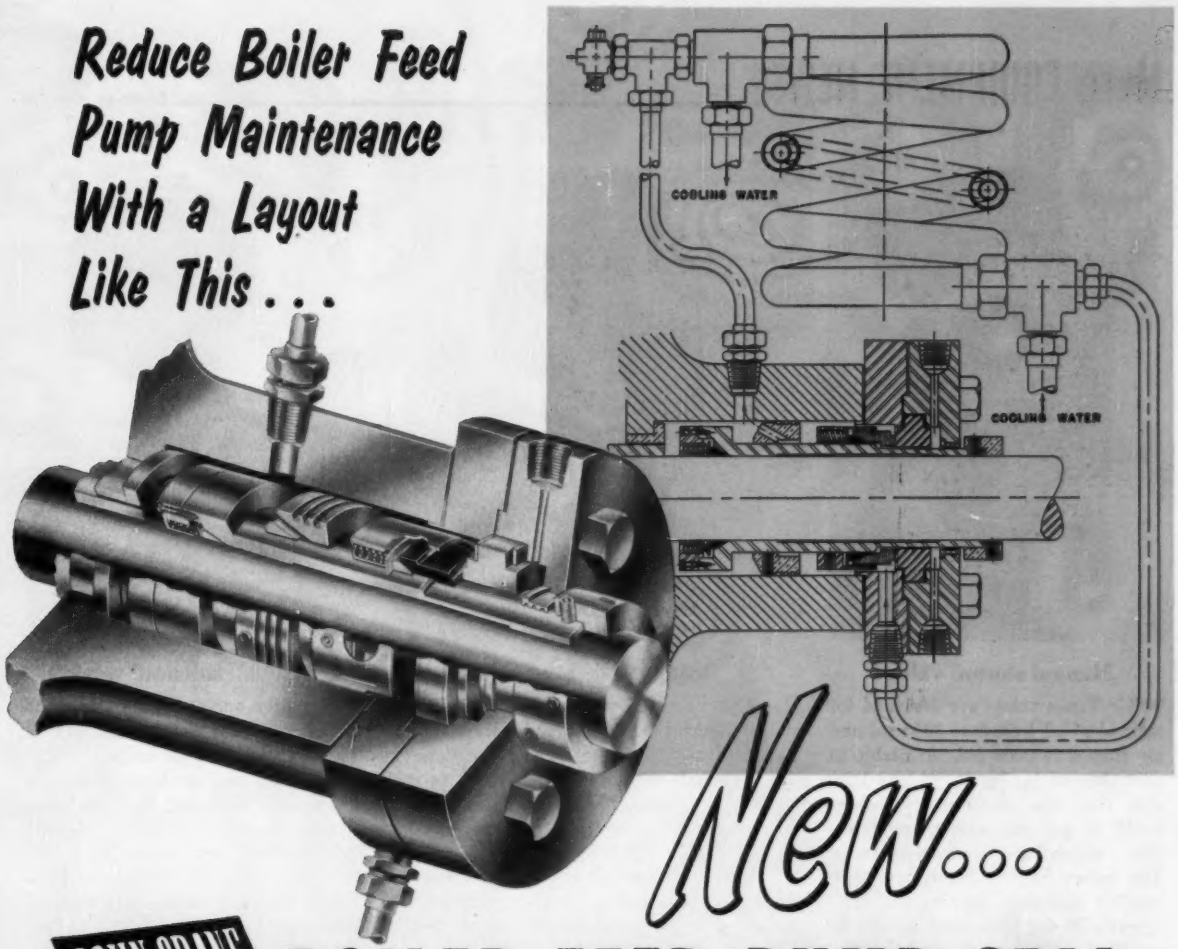
The steam-assist desuperheater controls reduced steam temperature at loads from 15 to 100 percent of maximum and gives close control down to 10 degrees above saturated temperature. Designed for in-line installation the desuperheater vaporizes cooling water. It is designed for use with any pipeline size, pressure or initial steam temperature.

Copes-Vulcan Division, Blaw-Knox Co, Erie 4, Pa.

For details on these items use post cards p 159. Identify request with item number.

Valve developments, index of other problem-solving items, turn page ▶

Reduce Boiler Feed Pump Maintenance With a Layout Like This . . .



New . . .

JOHN CRANE BOILER FEED PUMP SEAL

You get cost savings in four ways:

1. Replacement costs and "down time" are reduced. Service life is much longer than with other sealing methods.
2. Maintenance expenses are reduced. Once installed, the seal needs no further attention. Costly replacement of expensive sleeves is eliminated.
3. Long seal life—special closed circulating system provides cooling water in sealing chamber for best seal performance.
4. There is no leakage. Loss of valuable feed water is eliminated.

You get 4-way job-engineered performance:

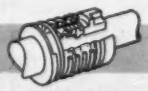
1. "John Crane" engineers the seal to your operation. This includes adaption to your pump design and piping arrangement.
2. You are furnished with carefully drawn up plans. All necessary recommendations are supplied. Heat exchanger size is specified.
3. Package design provides easy installation and removal of seal without major pump dismantling—can be installed as readily in existing equipment as in new pumps.
4. "John Crane's" world-wide service organization and experienced engineering staff stand behind your installation.

Now is the time to investigate this new boiler feed pump seal. Write for new illustrated technical bulletin.

Crane Packing Co., 6430 Oakton St., Morton Grove, Ill. (Chicago Suburb).
In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

JOHN CRANE

MECHANICAL PACKINGS


SHAFT SEALS

TEFLON PRODUCTS

LAPPING MACHINES

THREAD COMPOUNDS

CRANE PACKING COMPANY

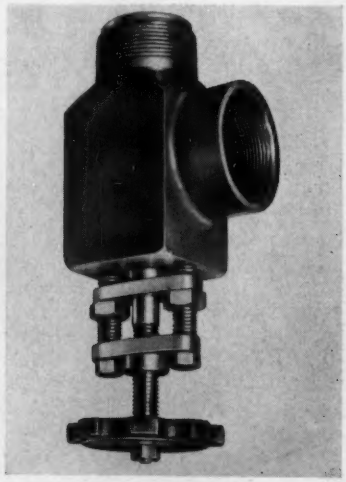
More EQUIPMENT NEWS

Begins on page 152

Manual shutoff valves

908 • These valves are designed for control of oil from 0 to 3000 psi and air from 0 to 2000 psi. Available in port sizes of ¼, ⅜, ½, ¾ and 1 in. npt, they can withstand velocities to 60 ft per sec without modification, according to manufacturer. The valves have a handwheel with position indicator, opening and closing in a 90 deg turn, but may also be supplied with conventional handle.

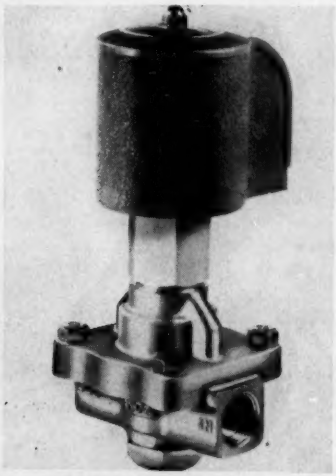
Barksdale Valves, 5125 Alcoa Ave, Los Angeles 58, Calif.



Drain or sampling valve

909 • Unit is recommended for installations where it is desirable to have the valve seat inside the vessel's wall to prevent liquid from remaining in nipple and valve. Completely self-draining it is available in ¾, 1, 1¼, 1½ and 2 in. npt. Outside screw and yoke construction makes it suitable for high temperature or corrosive service where inside threads cannot be tolerated.

Jerguson Gage & Valve Co, 80 Fellsway, Somerville 45, Mass.



Fuel oil solenoid valve

910 • Pilot-operated unit is used to automatically control the flow of heavy fuels to large industrial-type rotary and high-pressure atomizing burners. It has a full ¾-in. port and a pressure range of 15 to 300 psi; handles heavy fuels up to 200 F. Internal piston on downstream side of valve provides more power than necessary to open the valve and permits use of a strong closing spring.

Automatic Switch Company, 391 Lakeside Ave, Orange, N. J.

For more data on these items, use post cards on page 159. Identify your request with item number.

Block steel valves for high-temperature service

911 • Units are designed for hydraulic and air service up to 10,000 psig, on steam service to 2500 psig and on ammonia to 5000 psig. They are available in either inside or outside screw models.

Bolted-in seat construction eliminates screwed or welded-in seats and permits a wide range of seats and disks.

Strong, Carlisle & Hammond, 1392 W 3rd St, Cleveland 13, Ohio

Bronze gate valves feature cylindrical design

912 • These 125-lb bronze gate valves for steam, water, oil or gas are available in screwed, solder joint and brazing socket ends. Sizes are from ¼ through 3 in. New cylindrical body construction adds body strength and longer leakproof valve life, according to manufacturer. Descriptive bulletin 564 available on request.

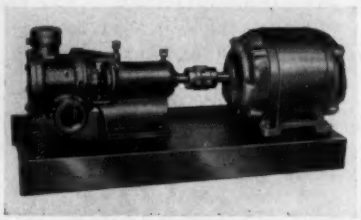
Kennedy Valve Manufacturing Co, Elmira, N. Y.

Time-delay valves are remotely located, controlled

913 • Line of 2-, 3- and 4-way valves provide delayed actuation with immediate reversal or immediate actuation and delayed reversal. Operating time of from 0 to 5 minutes delay may be accomplished by manual preset adjustment. Units may be remotely located, controlled from a central station.

Airmatic Valve, Inc, 7313 Associate Ave, Cleveland 9, Ohio

Be sure to check this item...



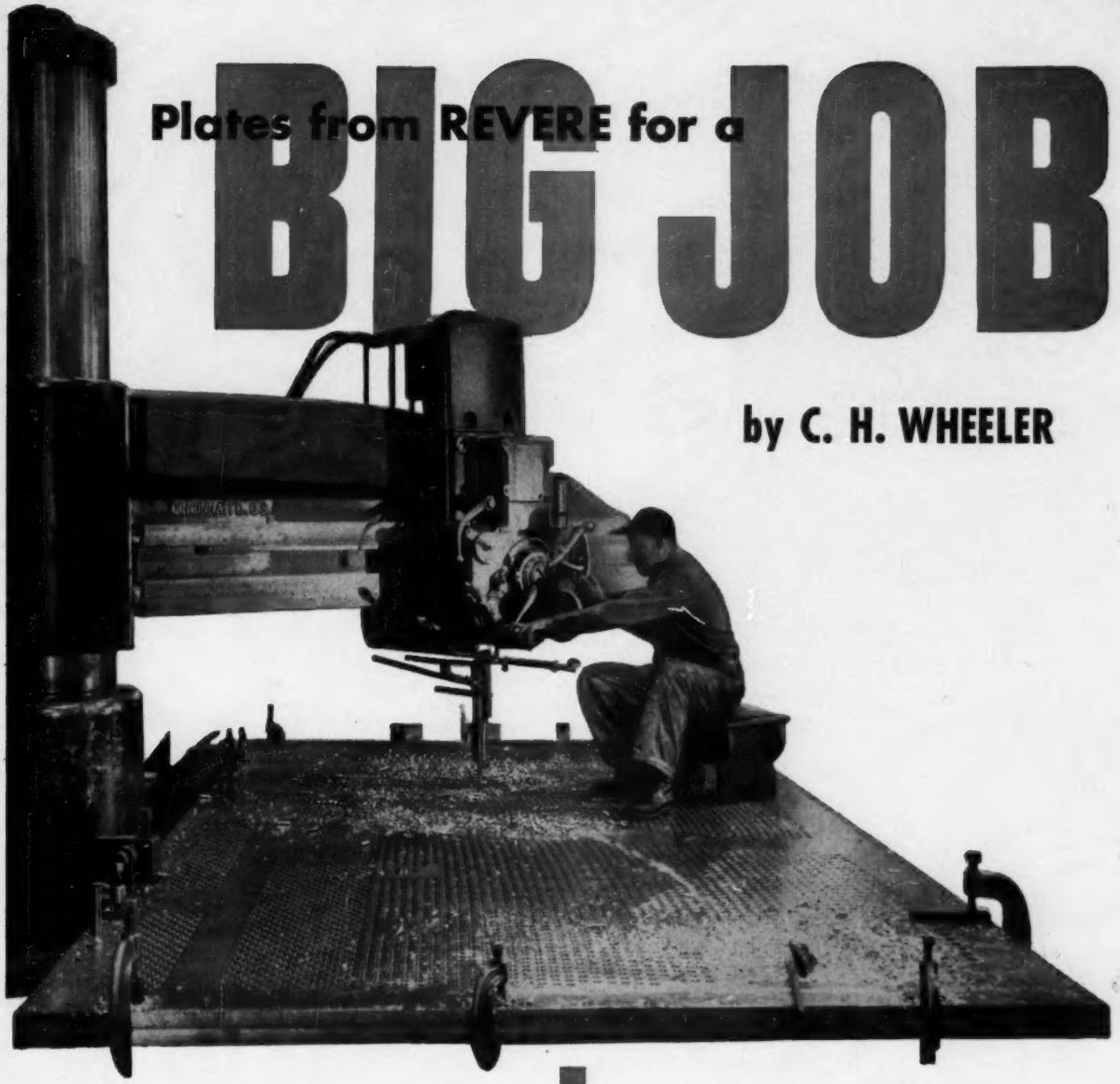
Turbine-type process pumps . . . . p 177

... and these and the many others appearing on pages noted below:

Helical speed reducers . . . . . p 164
Burner safeguard, control . . . . . p 166
Pressure-reducing valve . . . . . p 168
Traction-type fluid drive . . . . . p 170
Hydraulically-operated lift . . . . . p 174
Portable pumping system . . . . . p 178
Seamless bronze tubing . . . . . p 180

Plates from REVERE for a BIG JOB

by C. H. WHEELER



Here you see two rolled Muntz Metal condenser plates, being drilled simultaneously in the plant of the C. H. Wheeler Manufacturing Co., Philadelphia 32, Pa. The plates were supplied by Revere. They measure 100-¾" x 203-¾" x 1-½" thick. Four plates were supplied for a Wheeler 2-pass divided water box unit having 95,000 sq. ft. of condensing surface. The overall length of the condenser, including water boxes, is 48 ft., and overall height, including steam dome and hot well is 34 ft.

Revere is an important supplier of plates and tubes for condensers, heat exchangers, and similar equipment, shipping to all parts of the country. Collaboration on alloy selection and specification is freely available. Just get in touch with the nearest Revere Sales Office.

COPPER ★ BRASS ★ 18 01 ★ REVERE ★ ALUMINUM

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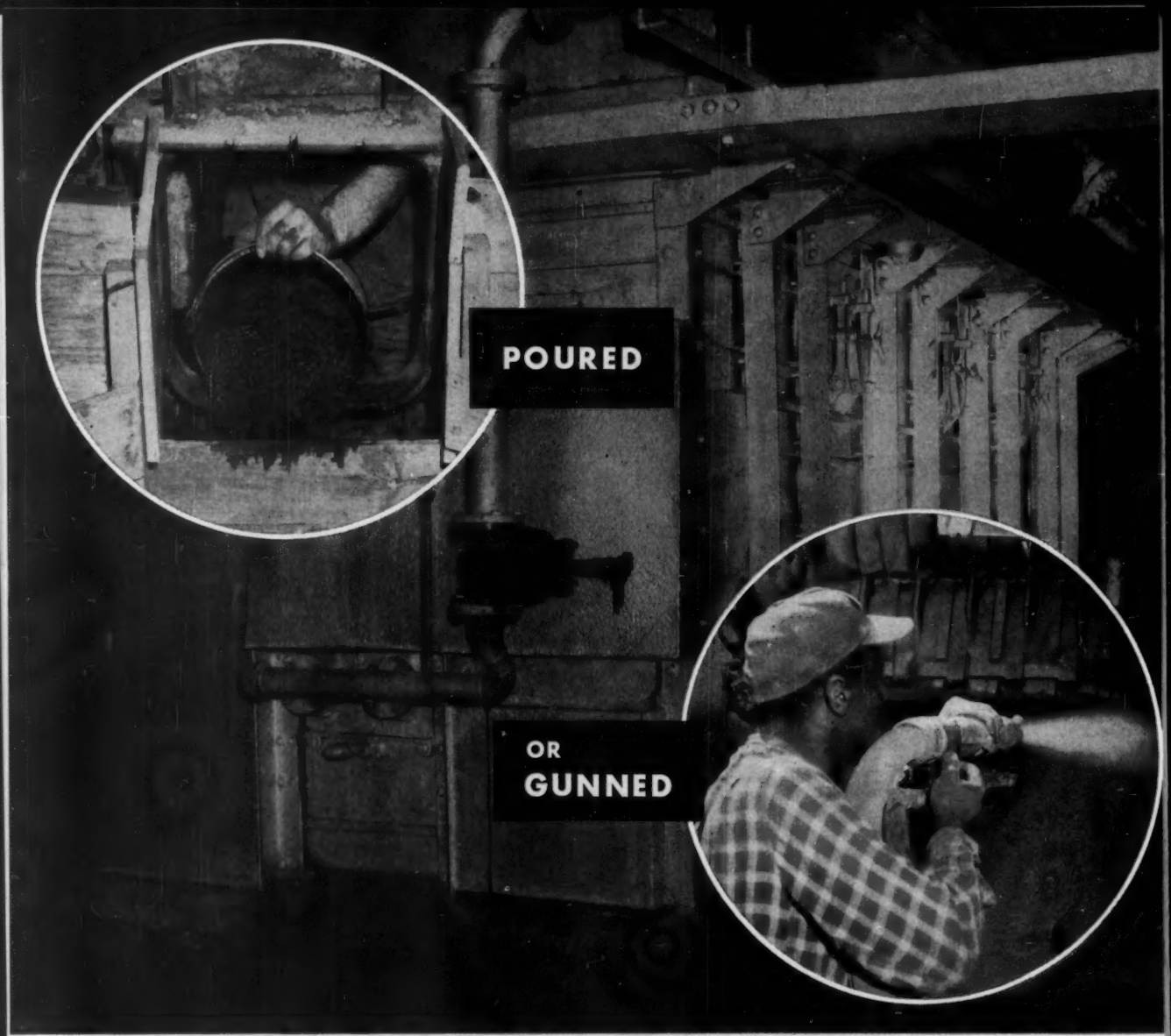

B&W Kaocrete Refractory Castables withstand punishing ashpit service

Continuous or intermittent sprays, high velocity water jets for ash removal, rakes and shovels — all these are responsible for the heavy abrasive and erosive attack on ashpit linings. But you can cut the frequency of maintenance and expensive relining jobs by using heavy-duty refractory castables which can be poured or gunned in place.

Specially designed for ashpit service, B&W Kaocrete D has the strength and hardness needed to stand up under these severe conditions. It has unusually high resistance to abrasion, erosion and spalling. Widely used in all types of boiler ashpit hoppers and slag tanks, Kaocrete D has proved its economy and durability. Where abrasive and erosive conditions are less severe, B&W Kaocrete A will give satisfactory service.

Your local B&W Refractories Engineer will be glad to give you complete details on the performance of these B&W Refractory Castables.

Send for Bulletin R-36 which gives data on B&W's wide line of specialized boiler refractories.

B&W REFRACTORIES PRODUCTS: B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick • B&W Refractory Castables, Plastics and Mortars • B&W Silicon Carbide

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R548

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AIR CONDITIONING, VENTILATING, REFRIGERATION AND HEATING

1 **Propeller fans** are subject of revised 39-p bulletin A-109B. Contains new fan sizes, revised air deliveries, specs, performance data and dimensional drawings. Shows standard propeller, utility, cool-blast, reversible and bi-pass duct fans, intake air units and unit heaters. Hartzell Propeller Fan Co, Piqua, Ohio.

2 **Test chamber** designed for controlled low-/high-temperature and relative humidity testing is discussed in 4-p, 2-color folder. Contains details regarding applications, performance, construction and specs. Tenney Engineering, Inc, 1090 Springfield Rd, Union, N. J.

3 **Axial roof ventilator** is described in illustrated bulletin DWA-101. Gives detailed information, performance tables, exhaust dissipation operating principle. Detroit Blower Co, 9867 Pacific Ave, Franklin Park, Ill.

★ **Cold generator** bulletin DS-352, in revised form, covers line of 10 through 150 hp packaged, reciprocating water-chiller units for industrial and commercial, comfort or process applications. Includes capacity tables on 10, 20 and 50 hp machines, data on 60, 75 and 100 hp cold generators, information on chiller inlet and outlet water connections, and complete data on 125 and 150 hp machines. ★Request direct on company's letterhead from The Trane Co, La Crosse, Wis.

4 **Motor compressors,** condensing unit for air conditioning are subjects of three pieces of new literature. Two of the bulletins provide specs and performance data for new 3-hp and 10-hp, F-22, suction-gas-cooled motor compressors. A third describes 10-hp F-22 remote condensing unit. Copeland Refrigeration Corp, Sidney, Ohio.

ELECTRICAL EQUIPMENT

5 **Synchronous motors** with split bearing-supporting end-shields are described in 4-p illustrated bulletin 05B8305. Contains information on standard construction features, modifications and excitation. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee. Wis.

6 **Interlocked armor cable** booklet 19-555 covers cable that is designed specifically for primary and secondary feeders in industrial power distribution systems and for generator leads, station auxiliaries and station control cables in electric power stations. Contains complete product listing, installation information and discussion of installed costs, material handling and space requirements. Lists cable types. Construction Materials Div, General Electric Co, Bridgeport 2, Conn.

(*Continued on pag* 208)

TURBINE AND DIESEL LUBRICANT GUIDE

CITIES SERVICE TURBINE OILS

Manufactured from the highest quality, solvent refined stocks, these oils have high viscosity index, excellent heat resistance. They are chemically fortified to prevent oxidation, rust, and foaming, permit smoother operation.

PACEMAKER 300-T

For use in the lubrication of steam turbines with single reduction gear units. Also for the lubrication of high-speed, ring-oiled, auxiliary turbines, where operating temperatures are not above 200°F.

PACEMAKER 500-T

Suitable for the lubrication of ring-oiled bearings of auxiliary turbines where operating conditions require an oil of heavier body than Pacemaker 300-T. Also recommended for use in separately lubricated turbine gear reduction units.

PACEMAKER 150-T

Recommended for pressure-circulation systems of direct-connected steam turbines, and for the bearings of turbo-generators where pressure-circulation of the oil is employed.

PACEMAKER 400-T

Recommended for the lubrication of propulsion turbine units on naval and commercial vessels, in pressure-circulation systems.

PACEMAKER 750-T

Recommended for the lubrication of high-speed, ring-oiled, auxiliary turbines, where operating temperatures are in excess of 200°F., and use of a heavier bodied oil is required.

CITIES SERVICE DIESEL OILS

Made in the world's most modern lubricating oil refinery at Lake Charles, Louisiana, Cities Service Diesel Oils are blended from highest quality, high V.I. mineral oils and fortified with specially developed additives. There's a Cities Service Diesel Oil tailored for top performance in every type of diesel operation.

D-C 300 SERIES

These oils are designed to fully conform to Military Specification MIL-L-2104A. Made from the finest base oils, they are strongly fortified against oxidation and corrosion. They have the necessary detergent-dispersant properties to insure superior lubrication performance in high speed Diesel engines operating under heavy duty service.

Recommended for service DG under A.P.I. classification system.

D-C 100 SERIES

These oils are designed to conform to U. S. Army Specification 2-104B (Supplemental List 1). They are also known as Superior Lubricants Series 1 and are intended for more severe service than the D-C 300 Series Oils. Particularly recommended for the lubrication of medium and high-speed Diesel engines using lower quality fuels.

Recommended for service DM under A.P.I. classification system.

D-C 500 SERIES

These oils meet the requirements of The Caterpillar Tractor Company for a "Superior Lubricant (Series 3)". They have the highest level of detergent-dispersant action with maximum oxidation and corrosion protection to assure reliable operation of Diesel engines under most severe service conditions or where low quality fuels of very high sulphur content are used.

Recommended for service DS under A.P.I. classification system.

PACEMAKER SERIES

The new Pacemaker line of Diesel engine oils is made from the same high quality base oils as are the Pacemaker T Series, and contains similar additives, but in lesser amounts. These oils are adaptable for use in many low and medium speed stationary engines operating under conditions which would not require the use of heavier fortified oils, such as the Pacemaker T Oils.

PACEMAKER T SERIES

These are medium duty, high grade, high V.I. oils fortified against oxidation, rust and foam. Admirably suited for slow and medium speed engines employing the dry sump system of lubrication and operating under conditions where the service is not severe enough to benefit from a full heavy duty oil.

NEPTUNE 9000 SERIES

Designed specifically for lubrication of marine-type Diesel engines, both military and commercial.

Neptune 9000 Series Oils are made from high quality, high V.I. solvent refined stocks and are strongly fortified against oxidation and corrosion. They are specially inhibited against silver alloy bearing corrosion and have the necessary detergent-dispersant properties to give maximum performance under severe operating conditions.

These oils conform to the requirements of Military Specification MIL-L-900 C (SHIPS) for marine Diesel engine lubrication.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

George Edwards

doesn't believe that curiosity killed the cat

►A COUPLE OF WEEKS AGO I was laid up with a sprained ankle for a few days. With my foot in a chair, I spent a lot of time with a little puzzle that George Dodds, our plant electrician, brought over one evening. It's just a square board with a marble in each of a number of holes. By jumping marbles over each other, the trick is to wind up with no marbles except one in the center. It's a real teaser.

George made it from a picture of one he'd seen somewhere. He'd barely finished telling me what it was before he was outlining some ideas for improving the thing. He had a half-dozen sketches in his pocket when he left.

This urge to build a better mousetrap is typical of the men who, like George, keep American industry humming. Pick any plant at random and I'll bet you'll find some home-grown gadget or hookup in use: a safety feature, a production short-cut, a laborsaver. Maybe it was the general manager's idea. Maybe a maintenance man thought it up. But curiosity led to the creative thinking that put it there.

We spend a lot of money for industrial research and our standard of living is proof of results. But all the answers to all the problems don't come from the labs. A lot of gold, some real nuggets, is mined from employes' suggestion boxes.

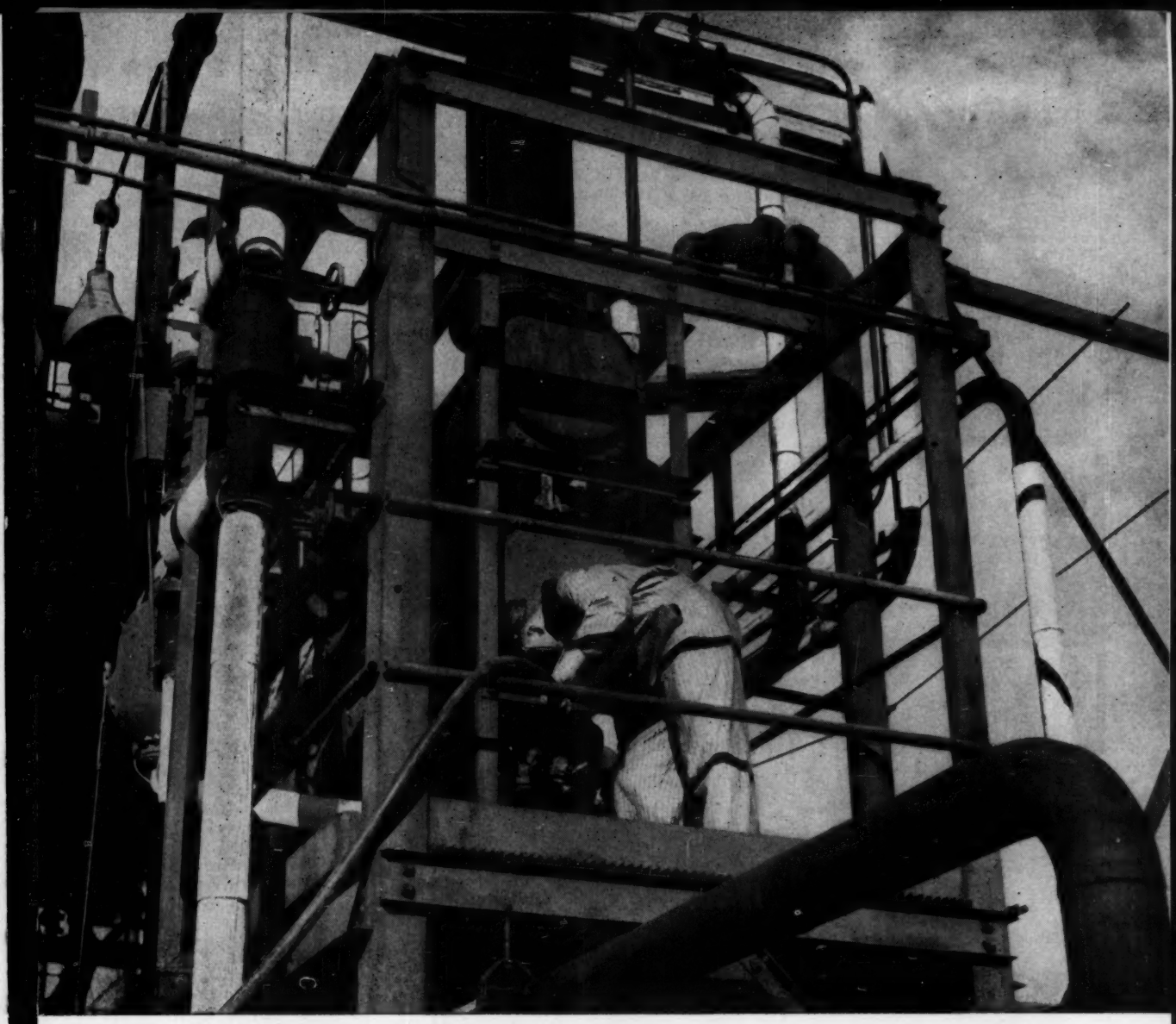
You may disagree with my associating curiosity with creative thinking. But, to me, intelligent curiosity is a kissing-cousin to imagination. And who does any creative thinking without imagination? I doubt if you'd find such a person.

Curiosity can lead to strange and wonderful events. Contrary to popular belief, the steam engine was invented before James Watt was born. A mathematical instrument maker by trade, he was asked to repair a model of the Newcomen engine. Until then, steam engines weren't practical. Curious, Watt experimented—and came up with the first *condensing* engine. The era of steam arrived.

Alexander Graham Bell was devoting his life to teaching deaf-mutes to speak. Knowing practically nothing about electricity, but curious about the possibility of making speech *visible* through vibrations (the original visual aid?) he tinkered with wires, springs, magnetos. Amusingly, it's said that he disliked the telephone in later years because it interrupted his experiments.

True, these are historic examples — but who knows what lies around the corner in the future? The most intelligent men are the first to agree that we know so little about so many things. Further, *we aren't sure we understand all we know.*

We're never too old to be curious. And don't believe that old saw about curiosity killing the cat. It's likely that the most curious cat of all was the one that swallowed the canary.



There's too much at stake —clean it right

Chemical cleaning involves costly equipment and often work stoppages. It's a job for experts. Let Dowell protect that equipment and keep production losses to a minimum when you have scale or sludge problems.

In over 15 years our trained engineers have serviced virtually every kind of equipment in plants, mills and refineries throughout industry. In fact, Dowell has cleaned over 10,000 boilers alone!

This experience means lower costs to you—in more thorough work, restored efficiency and less production loss.

Furthermore, Dowell engineers know you value the safety of your men and equipment. Dowell uses only the latest safety equipment and techniques to eliminate hazards and accidents. Our engineers work closely with your safety personnel to establish the safest possible working procedures.

Call the nearest of more than 165 Dowell offices. An experienced engineer will be glad to talk over and help you with your cleaning problems any time — at no obligation. Or write Dowell Incorporated, Tulsa 1, Oklahoma, Dept. I-23.

chemical cleaning service for industry

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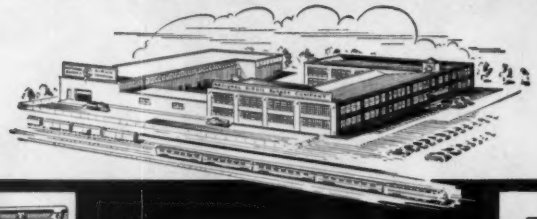

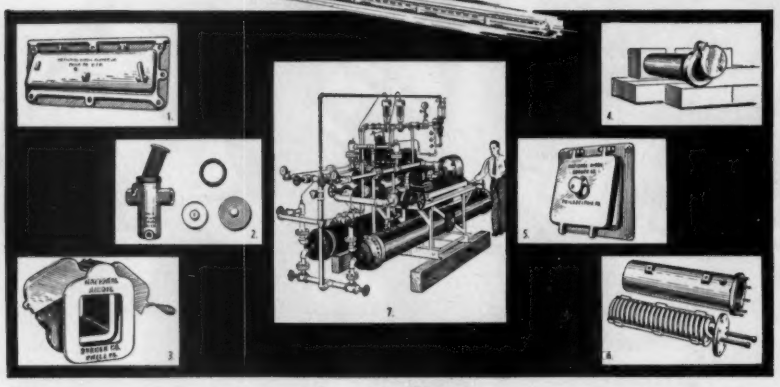

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1. Air Control Door and Frame, top hinged, ratchet type, heavy duty, for manual control. Surfaces are machined to a close fit.
2. Fuel Oil Suction Strainer, single type. Large basket area insures low pressure drop; cover and basket easily removed for cleaning.
3. Wide-View Peephole, safety, curtain type. Cobalt glass removed to show bearing surface for curtain. Curtain halves are interlocked—open simultaneously.
4. Ignition Port with Refractory Tile No. M896 . . . for use with standard 3" pipe. Also serves as a peephole.
5. Furnace Relief and Access Door, heavy construction, practically air tight. Door casting correctly weighted, lined with plastic refractory retained by imbedded grill; with observation port and cover.
6. Fuel Oil Heater, Self-Cleaning, Spiral Coil type. High oil velocity in coil, resultant turbulence prevents carbon formation. No internal connections or joints.
7. Fuel Oil Pumping and Heating Unit . . . Twin or Single Pumps, Steam driven, Electric driven or combination Steam-Electric, with Single or Double Fuel Oil Heaters and accessories for feeding oil at constant pressure and temperature.

. . . yes, just as we are proud of supplying the *right* liquid fuel or gas burning equipment (over 40 years experience throughout industry), so, also, are we proud of our full line of highest quality accessories to supplement your every combustion need. Within our modern, "daylight" factory, salesrooms and general offices NATIONAL AIROIL likes and adheres to the phrase, "nothing but the best"! We believe that our record speaks for itself . . . i.e.; the "right combination" for you in achieving maximum combustion economy is: NATIONAL AIROIL Fuel Oil, Gas or Combination Oil and Gas Burning Equipment; NATIONAL AIROIL Combustion Accessories; and, NATIONAL AIROIL Engineering Consultation.

May we be of help to you in accomplishing your particular installation or in solving that difficult problem?

CHEMICAL-PETROLEUM DIVISION

NATIONAL AIROIL BURNER CO., INC.

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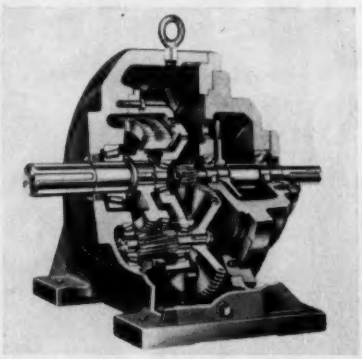
Southwestern Division: 2512 South Boulevard, Houston 6, Texas

INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

More EQUIPMENT NEWS

Begins on page 152



Helical speed reducers

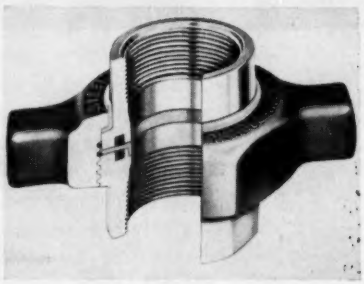
918 • "In-line" units are available in 18 sizes, in single, double or triple reductions. Features claimed include: quiet crown-shaved and induction-hardened helical gearing; oversize thrust bearings; large overhung load capacity; steel shafts and cast-iron housings.

Backstops can be furnished with reducers or installed in the field without further machining of housings. All bearings, housings and gears conform to AGMA specifications.

Units are available in reduction ratios from 1.25:1 to 205:1 and in hp capacities from 1 to 110. For installaton in most any position, these units may be directly coupled or driven from chain or belt drives on either the driver or driven shafts, or both. Request details from manufacturer.

Philadelphia Gear Works, G St below Erie Ave, Philadelpha, Pa.

For more details on these items, use post cards p 159. Identify your request with item number.



Oil pipe insulating union

922 • The problem of keeping current from traveling into adjoining pipe sections on oil and gas production lines is said to be solved by a newly developed insulating handle-bar union.

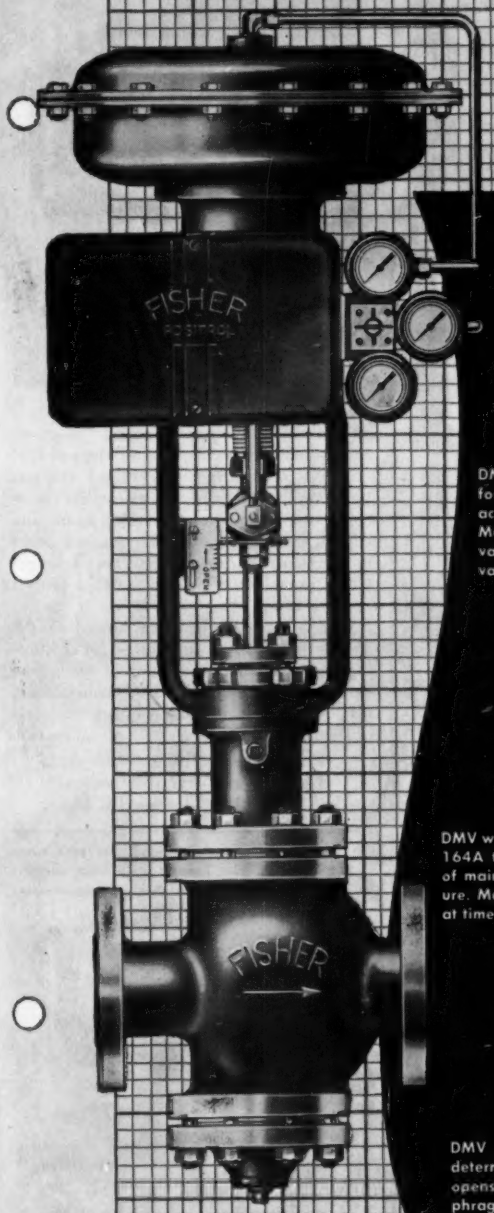
Insulating gaskets are nylon fabric, impregnated with *Hycar* rubber, and are said to remain pliable after long service. Center positioning of the gasket is maintained by shoulders. This positioning also prevents damage to the gasket as union is assembled.

The unions range in size from one to three inches and are designed to provide positive insulation on pipelines up to 3000 psi. They are built of forged steel, have

FISHER®

THE ANSWER TO YOUR

Control Problem

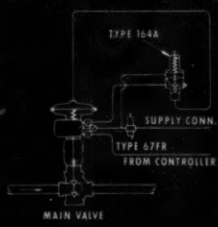


Built for your specific requirements, Fisher Diaphragm Motor Valves are manufactured to handle pressure conditions up to 30,000 pounds, for high pressure drops and are available in metals for highly corrosive service and alloys for high temperature work.

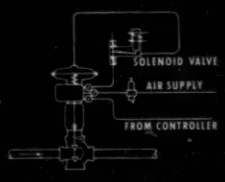
TYPICAL EXAMPLES OF FISHER DIAPHRAGM MOTOR VALVE WIDE RANGE ADAPTABILITY

DMV with Hand Jack Operator. Allows for manual operation against spring action. Limits travel of valve. Example—Maximum opening in spring opened valve. Minimum closing in spring closed valve.

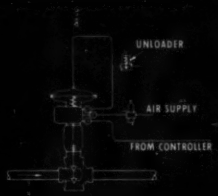
DMV with Continuously Connected Handwheel. Operator can open or close valve against controller action. Can operate valve manually if operating medium fails. Can set maximum opening or minimum closing of inner valve.



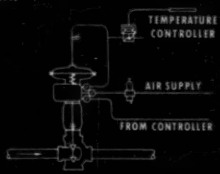
DMV with Air Lock-up system using Type 164A to close air circuit to diaphragm of main valve in case of plant air failure. Main valve will be held in position at time of supply pressure failure.



DMV with Remotely Actuated Electric Solenoid Trip Out. Valve may be fully opened or closed by unloading operating pressure from diaphragm by solenoid operation. Solenoid is actuated from manual switch or an electric tie-in circuit.



DMV with Air Cut-out Feature. At predetermined pressure setting, unloader opens and bleeds pressure off diaphragm to keep main valve open. Unloader orifice is larger than controller orifice so main valve remains open. Operation restored by putting thumb over open end of unloader.



DMV with Auxiliary Controller Override. An auxiliary controller, such as temperature, placed in operating air line to diaphragm—can over-ride action of main control function by unloading diaphragm and taking over functional operation of DMV.

FISHER GOVERNOR COMPANY

MARSHALLTOWN, IOWA • WOODSTOCK, ONTARIO

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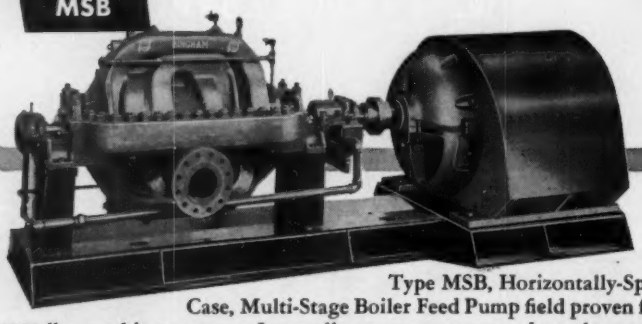
Bingham

"DOUBLE VOLUTE"
BOILER FEED PUMPS

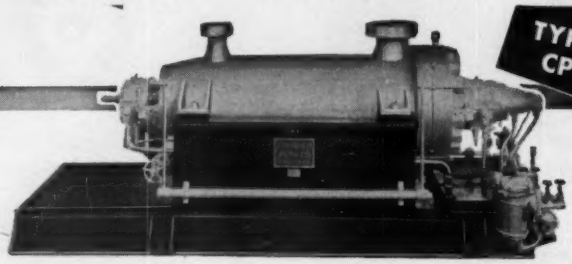
for the ultimate in dependability
IN HIGH PRESSURE SERVICE

TYPE MSB



Type MSB, Horizontally-Split Case, Multi-Stage Boiler Feed Pump field proven for 1200 lbs. working pressure. Integrally cast cross-overs and evenly spaced case bolting located uniformly close to the shaft center line, enclosing a minimum pressure area, eliminate case distortion and inter-stage jetting.

TYPE CP



Type CP, Multi-Stage, Double-Case Boiler Feed Pump with forged outer barrel for high pressure service.

All BINGHAM Boiler Feed Pumps feature: (1) "Double Volute" construction, resulting in full radial balance of the rotating element *throughout the entire operating range of the pump.* (2) Double suction first stage for low NPSH. (3) Balanced axial thrust (no balancing drums needed). (4) Kingsbury Thrust Bearings. (5) Stuffingboxes subjected to suction pressure only. (6) Design for High Speeds.

Bingham PUMPS
SINCE 1921

DOUBLE VOLUTE
RADIAL BALANCE

BINGHAM PUMP COMPANY
General Offices: 2800 N. W. Front Ave., Portland 10, Oregon
Factories: Portland, Ore. • Vancouver, B. C., Canada

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New Orleans, La.	Toronto, Ont., Can.
Vancouver, B. C., Canada	

More EQUIPMENT NEWS

Bgins on page 152

cadmium plated ends, a Parkerized nut and two oil-resistant O-rings forming the seat between the male and female ends.

Clayton Mark & Co, 1900 Dempster St, Evanston, Ill.

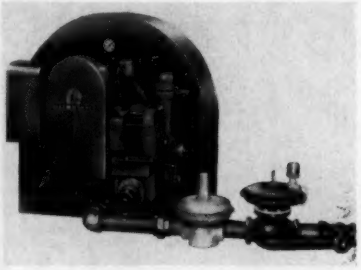
Burner safeguard, control

919 • *Fireye* primary control programs and safeguards the operating sequence of fully-automatic rotary register oil and gas burners. It uses two flame-sensitive scanners—one to monitor the pilot flame and supervise the light-off sequence, the other to safeguard the main flame. This arrangement provides additional safety against off-ratio firing.

During normal operating procedure the system provides for pre-purge, pilot proving, limited trial-for-ignition of main fuel and post-purge periods. If a flame failure occurs either during the startup or operating periods, all fuel is shut off within one second, manufacturer states.

Electronics Corp of America, 718 Beacon St, Boston 15, Mass.

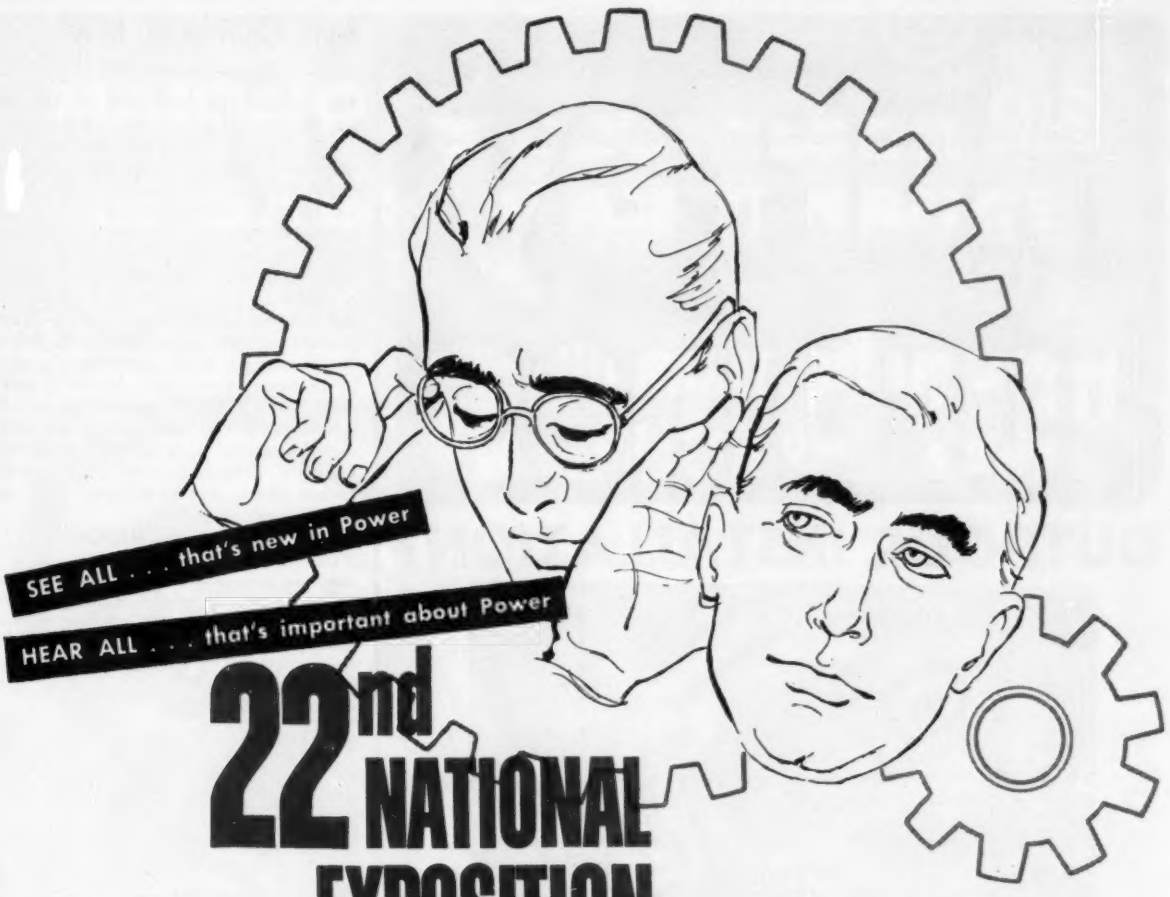
For more details on these items, use post cards p 159. Identify your request with item number.



Combination gas-oil burners

917 • Combination gas-oil burner for industrial applications has an integral air register which eliminates the need for a costly checker floor and reduces installation time according to manufacturer.

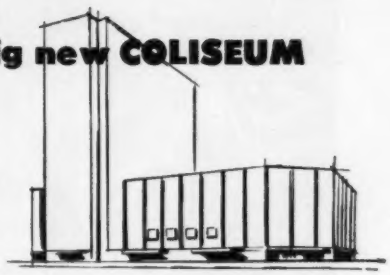
Burner section and air register are shipped as separate units. They may be bolted together on the job. Oil burner is designed to fire with No. 6 or lighter



22nd NATIONAL EXPOSITION of POWER & MECHANICAL ENGINEERING

Under auspices of ASME

Nov. 26-30, 1956, In New York's big new COLISEUM



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Efficient production and use of Power? Hundreds of up-to-the-minute absorbing exhibits will show you what's new and answer your questions, help solve your special problems. You'll meet with scores of men with the same interests, you'll exchange information, you'll get vital new ideas. If your interest is Atomic Energy, you'll find a whole section devoted to this subject.

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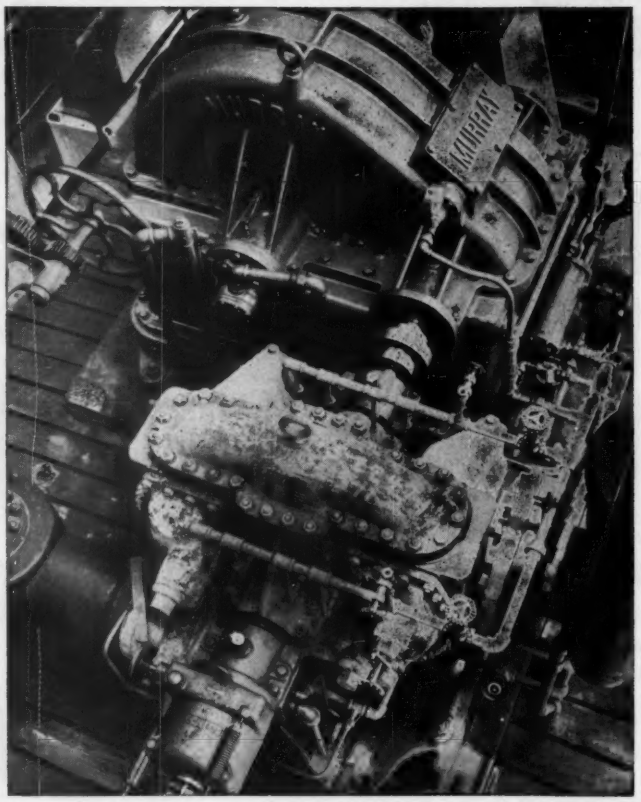
MANAGEMENT: INTERNATIONAL EXPOSITION COMPANY

Murray Turbines

OUTDOOR INSTALLATION?



THE RIGHT ANSWER—MURRAY

The turbo-gear unit shown above has been installed outdoors with virtually no weather protection for many years. The turbine exhausts to a process line carrying 170 psig pressure. Yes—for rugged applications—the right answer—MURRAY.

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

More EQUIPMENT NEWS

Begins on page 152

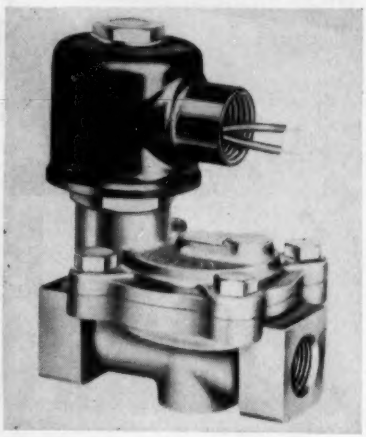
oil. Ratings run from nine to 125 gal per hr.

The ring-type gas burner may be used with either natural or manufactured gas. Capacities range from 1,650,000 Btu input per hr to 18,750,000 Btu input.

Fuel changeover is effected by operating a selector switch or by reliance on automatic controls. No mechanical changes are necessary. Electronic combustion controls automatically shut down the burner in case some abnormal condition arises. Programming control schedules sequence of all burner operations. Automatic magnetic starter switch is provided for the oil burner motor. Factory wide control panel may be secured as accessory equipment. Complete information, including specifications sheets, may be obtained from the manufacturer on request.

Iron Fireman Mfg Co,
Cleveland 11, Ohio

For more details on these items, use post cards p 159. Identify your request with item number.



Diaphragm-type solenoid valve

936 • Unit is designed especially to meet need for an "off-the-shelf" multi-purpose valve. Because of its diaphragm action and full flow ports, it is capable of handling large capacities with minimum pressure drop, manufacturer states. This makes it suitable for shutoff control of a large variety of liquids and gases over a wide range of operating pressures up to 250 psi.

Available in ⅜ and ½-in. ips, the valves are normally closed and feature forged brass bodies, packless construction, bubble-tight shutoff and two wire continuous duty solenoids. Full details from manufacturer.

General Controls Company,
Glendale, Calif.

Pressure-reducing valve

937 • Air-loaded diaphragm-operated unit is for steam heat and process steam applications. There are only two moving parts to the unit—a metal diaphragm with full valve travel and a hardened stainless steel main valve that seats on a renewable stellited seat ring.

An air loader replaces conventional load-

MAKING Great Savings in GAUGE MAINTENANCE

(BOTH TIME AND COST)

DIAMOND "Multi-Port" BI-COLOR GAUGE

SMALL ROUND PORTS INSTEAD OF LONG GLASS AND MICA STRIPS
GAUGE NEVER REMOVED FROM BOILER FOR GASKET CHANGES OR OTHER NORMAL MAINTENANCE
STEAM SHOWS RED
WATER SHOWS GREEN
COMPLETE PORT CHANGE REQUIRES ONLY ABOUT 15 MINUTES
EACH PORT THERMALLY INDEPENDENT

The Diamond "Multi-Port" Bi-Color Gauge makes startling reductions in maintenance costs. In cases where accurate records have been kept, labor and material costs are less than 1/5 the maintenance of conventional open port gauges. This is due to the unique design . . . note particularly the advantages that are pointed out on the photograph.

The "Multi-Port" operates on the Bi-Color principle . . . steam always shows red . . . water always shows green. There can be no question of water level. The gauge has been in continuous successful high pressure operation for more than three years in leading central station plants. Users report excellent readability and exceptionally high availability as well as important reductions in maintenance. Return the coupon below to get a copy of Bulletin 1174U.

7320

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO

Diamond Specialty, Limited — Windsor, Ontario

DIAMOND POWER SPECIALTY CORP. U
LANCASTER, OHIO

Please send me without obligation a copy of new Bulletin No. 1174U explaining the advantages of the Diamond "MULTI-PORT" Bi-Color Gauge.

NAME_____

COMPANY_____

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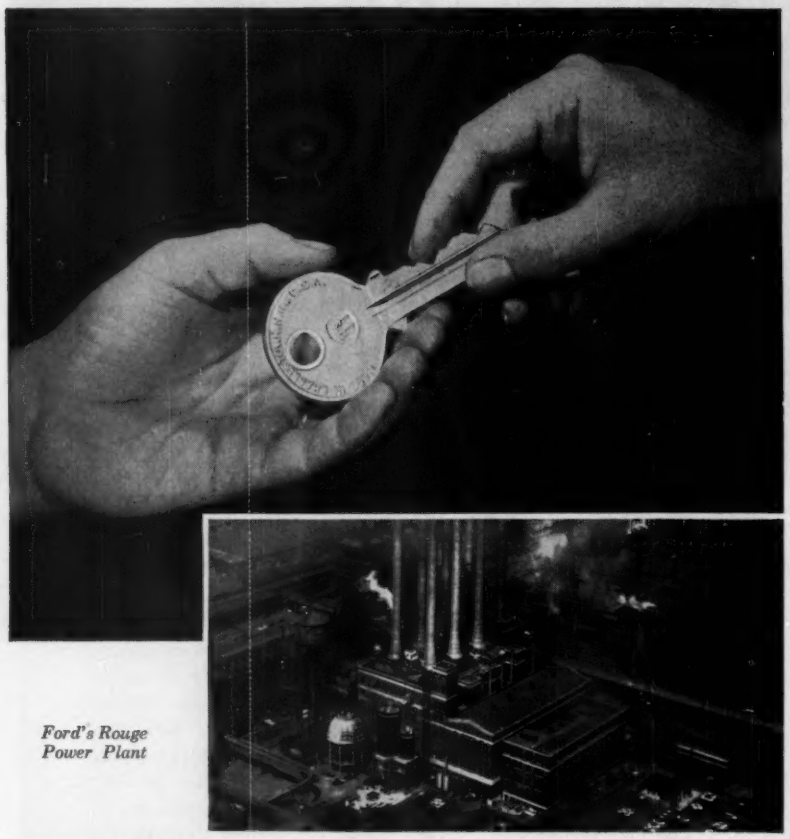
WHY A TURN-KEY PROJECT IS BEST FOR YOU



Ford's Rouge Power Plant

A Turn-Key project is a "packaged" service that combines engineering and construction in a single contract . . . and that may include other services such as preliminary investigations, studies and site selection, procurement of materials and equipment, initial operation of the finished plant.

Advantages to you:

LESS COST: Who is better qualified to construct a project than the firm that designs it? In a Turn-Key project one organization performs both engineering and construction services; details are handled quickly, efficiently—therefore more economically.

LESS TIME: Excavation can be made and foundations started several months prior to the release of the Engineer's completed design drawings and specifications. Construction follows blue prints—promptly. This scheduling of design and procurement to meet construction requirements permits the project to advance in an unbroken sequence—setting the stage for a faster delivery of the completed plant.

MORE SERVICE: One contract gives you *complete* service—no question about responsibility. Thus you have better control and more closely integrated planning.

We offer you engineering and construction services separately but suggest you consider combining them into a Turn-Key project that will save you both time and money. Write today for this free booklet describing the advantages in detail.

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The Kuljian Corporation

engineers • constructors

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More EQUIPMENT NEWS

Begins on page 152

ing spring, produces a constant loading force on diaphragm. This assures same control point over full valve travel.

The valve is available in cast iron in sizes ½ to 2 in. with screwed end connections. Inlet pressure range is 0 to 250 psi, 450 F. More data in bulletin 561, obtainable from manufacturer.

Leslie Co, Lyndhurst, N. J.

Pint-sized fire fighter

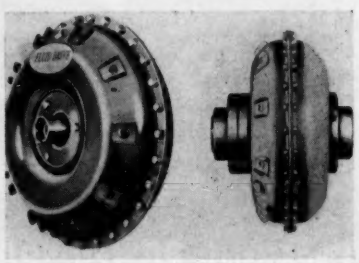
935 • Tiny fire alarm plugs into any standard ac outlet and shrieks an ear-splitting alarm at the first sign of fire or ominous overheating. Intended for plants, offices, stores, warehouses and homes, it can be easily and inexpensively planted wherever fire could start without easy detection.

Portable, reusable alarm draws no current except when signaling and may be used as a substitute for, or companion system to sprinkler and other standard fire-detection and fire-fighting systems.

Thermostat triggers the alarm when heat reaches 140 F and continues it until conditions return to normal. Can be tested by holding a lighted cigarette or match to the thermostat button on its face.

Laramie Chemical Corp,
290 Main St, Stamford, Conn.

For more details on these items, use post cards p 159. Identify your request with item number.



Traction-type fluid drive

938 • Basic unit is designed for industrial use with internal-combustion engines as a fluid power transmission for mobile material-handling vehicles and construction equipment. Power rating in these ap-

TRY THESE ADVANCED-DESIGN

STRONG STEAM TRAPS

...you'll never settle for anything less

tough—semi-steel, cast steel or forged steel construction takes hard usage . . . lasts a lifetime

trouble-free—all-stainless moving parts resist corrosion . . . slash maintenance costs

steam saving—dual-fulcrum inverted-bucket design heats equipment faster . . . keeps it hotter

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priced right—cost no more than other leading traps . . . offer much more

- Strong Steam Traps are available in various sizes and capacities . . . from 0 to 2500 psi and to 1100°F. For complete details see your *Strong Distributor or write for Bulletin SS40C.*

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1392 WEST 3rd STREET . CLEVELAND 13, OHIO

air traps • strainers • reducing valves • vacuum or pumping traps
continuous blowdown valves • separators • engine stops • F and T traps

BELMONT "Centrifugal"

protects pump shafts against scoring . . . wear

Belmont Type 754-P is a "custom made" packing for centrifugal and rotary pumps. Its reputation as "nothing better for the service", has been gained through years of highly satisfactory performance.

Secret of success? *Lubrication* that allows shaft free motion. Lubrication that is impregnated into every strand of asbestos yarn, and graphiting that is braided into this packing to stay, throughout its life.

Try Belmont "Centrifugal" 754-P in your plant and keep a check on the condition of your pump shafts. You'll stay with it.

Ask your U. S. Gasket-Belmont Packing Distributor or write for Catalog.

THE BELMONT PACKING & RUBBER COMPANY
Butler & Sepviva Streets
Philadelphia 37, Pennsylvania

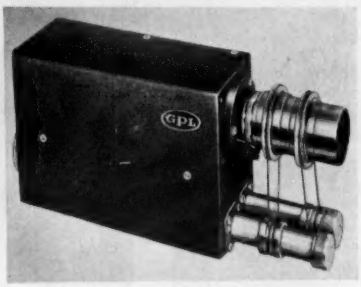
U.S. GASKET • BELMONT PACKING

More EQUIPMENT NEWS

Begins on page 152

plications is 25 to 85 hp, depending upon drive speed. When modified by installation of a flexible coupling, half on each end of the fluid drive, unit is well suited to constant speed electric motor applications for driving production and processing equipment, conveyors and other material handling installations. As a motor-driven unit it is rated 7½ to 15 hp for 1200 rpm drive speed and at 25 to 50 hp for 1800 rpm. Request details from manufacturer.

American Blower Corporation, Detroit 32, Mich.



Industrial TV camera

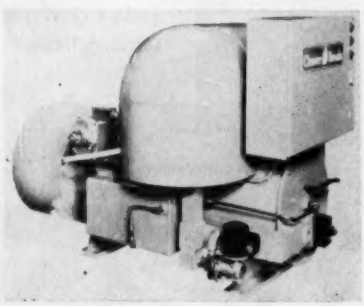
939 • *Model PD-152* camera has been designed for operation in high-vibration, noise and environmental conditions encountered in manufacturing, engine test stand, research, military application, etc.

Weighing six pounds and with case measurements of 3x5x9 in., the camera has a 525 line system, 60 fields interlaced, with a resolution of 550 lines. Power requirement has been reduced to a minimum to increase application versatility.

Two gear motors with drive clutches are available for remote iris and focus adjustments. Only the camera is required at the pickup scene since monitor and control operations may be handled at a remote point. The camera can be clamped or mounted to a structure, yet has sufficient rigidity to prevent movement of the lens and resulting optical blurring of the image. Request details from manufacturer.

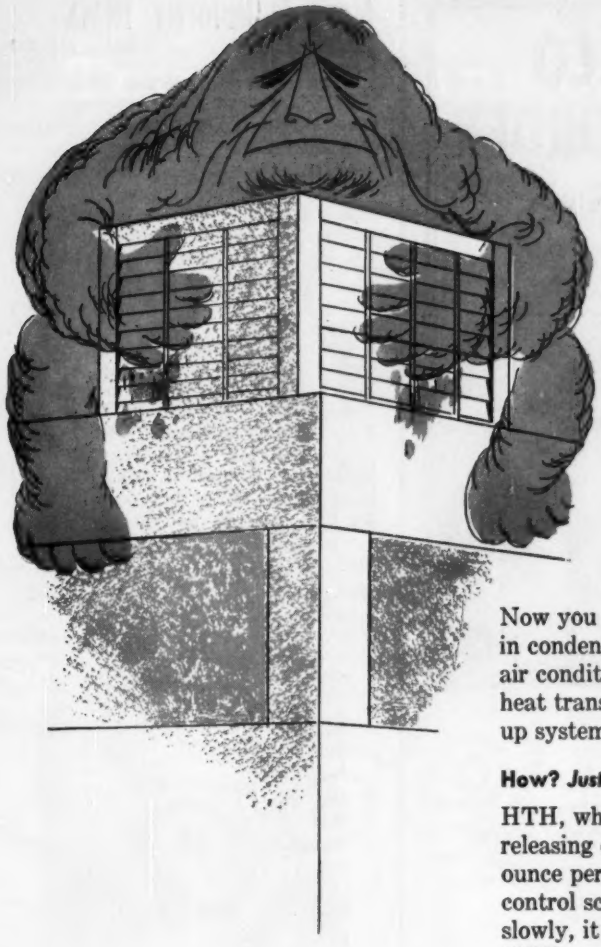
General Precision Laboratory, Inc, Pleasantville, N. Y.

For more details on these items, use post cards p 159. Identify your request with item number.



Air atomizing burner

915 • Gun-type burner designed for No. 6 oil burns 90-gal per hour. Manufacturers claim that maximum efficiency is insured by the metering of oil and air in the



HTH® rids water systems of green scum

Now you can eliminate troublesome algae growths in condensers, spray towers, cooling ponds, reservoirs, air conditioning equipment . . . algae growths that cause heat transfer loss, produce offensive odors, and clog up systems using recirculated water.

How? ***Just use HTH Granular.***

HTH, when added to water, dissolves quickly, releasing chlorine to provide sure, fast algae kills. One ounce per 1000 gallons of water is generally sufficient to control scum growths. Because these growths form slowly, it is only necessary, in most cases, to add HTH periodically or as a "shot" treatment to obtain the desired results. Frequency of application depends on the nature and condition of the specific water supply.

HTH is dry, stable, easy to use. Containing 70% available chlorine, it is packed in 100-lb. drums and in cases of nine 5-lb. cans. Get all the facts about this safe, effective, economical way to prevent algae growths. *Mail the coupon today.*

MATHIESON

OLIN MATHIESON CHEMICAL CORPORATION
Industrial Chemicals Division
Baltimore 3, Maryland

Please send me full information on the use of HTH to prevent algae growths.

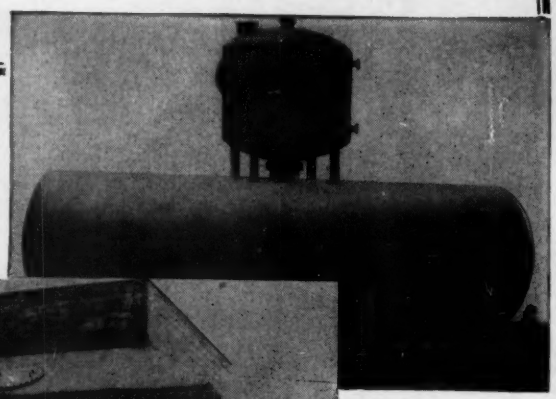
Name_____ Title_____

Company_____

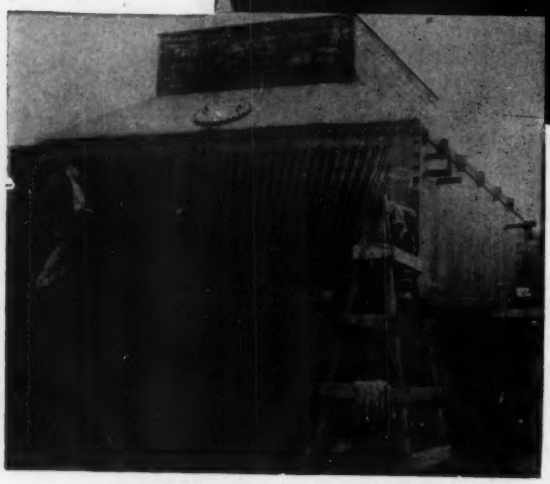
Address_____

3734

SATISFIED PUERTO RICO SENDS ANOTHER ORDER FOR CONSECO



Right: 500,000 lb/hr deaerating feedwater heater with 22,000 gal. storage tank.



Left: CONSECO supplied a 45,000 sq. ft. condenser, air ejector for Unit No. 5.

FOR THE SAN JUAN STEAM ELECTRIC STATION

The San Juan Steam Electric Station of the Puerto Rico Water Resources Authority has been so satisfied with Conseco condensing and feedwater heating equipment already installed and operating with Units 1, 2, 3, and 4, they ordered additional Conseco equipment, shown above, for Unit 5. The heating section on top of the 36½ ft. storage tank is 9 ft. in diameter, 10 ft. high, A.S.M.E. Code. This is the largest heating unit in the plant, part of the feedwater heating system for the 44,000 KW turbo generator system.

Send for Bulletins giving complete engineering data on these products.

EQUIPMENT DESIGNED AND BUILT BY CONSECO

HEAT EXCHANGERS • CONDENSERS • EVAPORATORS • STEAM JET AIR EJECTORS • STEAM GENERATORS • PRESSURE VESSELS CENTRIFUGES • FILTERS and STRAINERS • PUMPS, INSTRUMENTS, SPECIALTIES

CONDENSER SERVICE & ENGINEERING CO., INC. CONSECO

Designers and Builders of Equipment for Power, Refining, Chemical and Marine Industries

164 OBSERVER HIGHWAY HOBOKEN, N. J.

More EQUIPMENT NEWS

Begins on page 152

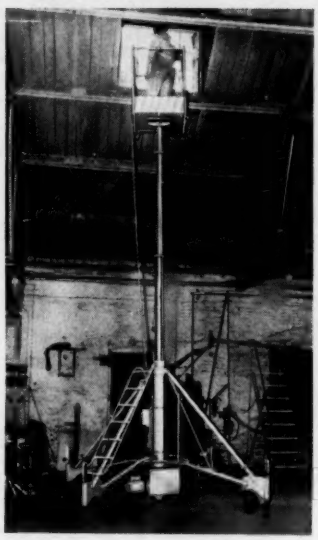
proper ratio at all capacities. Oil is finely atomized so that it burns easily and completely. Positive acting meter pump gives measured delivery of oil. Once burner is set for the most efficient combustion it remains at that point indefinitely.

Low fire start assures safe, smooth ignition and prevents puff. Burner starts with a small flame which is gradually built up to the required size. Shape of flame is adjusted for the type of boiler it is to be used with.

Combustion controls offer complete protection under all conditions. Motor start is delayed until the oil at the nozzle is heated. Burner is instantly sensitive to heat demands and provides steady heat for power loads and heating. Burner is fire tested at the factory and comes as a complete package, wired and ready for service lines. Request full details.

Cleaver-Brooks Co, 493 E Keefe Ave, Milwaukee, Wis.

For more details on these items, use post cards p 159. Identify your request with item number.



Hydraulically-operated lift

927 • Unit is designed for maximum reach of 42 ft above floor level. It can be used indoors or out—folds up to pass through doorways, narrow corridors or in and out of elevators. Stability is achieved by screw-type leveling jacks at each corner.

A ladder provides access to the platform in the "down" position. The mechanic has complete control for raising, stopping and lowering by means of a pushbutton control located on the platform's guardrail. The platform can be rotated through 360 deg, is load rated at 350 lb.

Six standard models with maximum reach from 19 to 42 ft are available. All have 110-v 60-cycle single-phase pump motor plus hand-operated pump for use where electric power is not available or when power shutdowns occur.

Ballymore Co, Wayne, Pa.

(*Continued on page* 177)

Tough Expansion Joint Problem?

Put the Badger Man on the Spot!

Complex expansion joint problems are *best* analyzed at only one place: your office or plant site. It's there alone that *all* essential data about your proposed installation is available.

And it's there — *on the spot* — that the Badger Man is ready to apply his unique abilities. He is a trained engineer *and* he brings to your problem the background of the world's most experienced manufacturer of expansion joints.*

Next time you are confronted with a complicated piping layout, severe operating conditions, unusual size and shape requirements — *any* complex expansion joint problem — put the Badger Man on the spot! His services are as close as your telephone.

COMING SOON — Badger Service-Rated Expansion Joints. Incorporate revolutionary new features developed during three years of intensive research and testing. Watch for this important announcement.

bmc

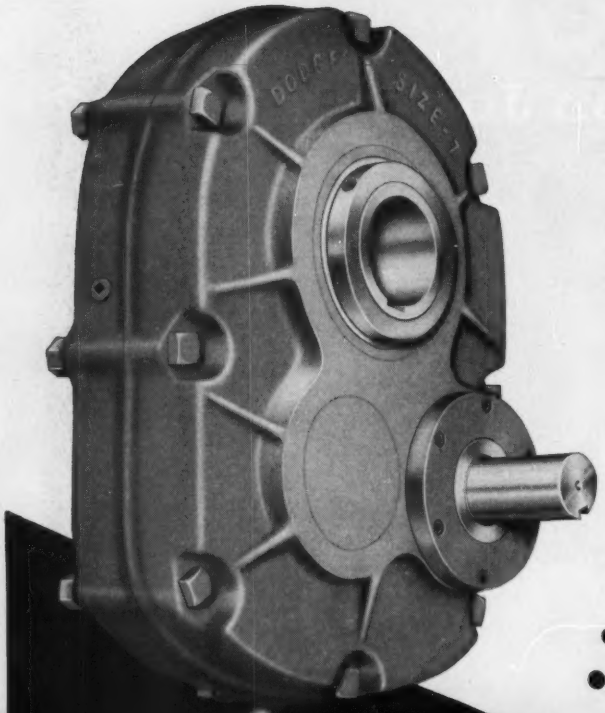
BADGER EXPANSION JOINTS

BADGER MANUFACTURING COMPANY

230 Bent Street, Cambridge 41, Massachusetts • 60 East 42nd Street, New York 17, New York

Representatives in principal cities

*Badger has been solving tough expansion joint problems for 50 years — a record unmatched by any other firm.



97% EFFICIENCY

- NO FOUNDATION
- NO FLEXIBLE COUPLING
- NO SLIDING BASE
- NO LINING UP PROBLEM

—that's Torque-Arm

THE DODGE SHAFT-MOUNTED SPEED REDUCER

Proved in tens of thousands of installations, in all types of industry, this new and better kind of speed reducer delivers up to 97% efficiency . . . makes savings up to one-third!

Mounted directly on the driven shaft, the reducer is anchored by the Torque-Arm, fastened to any fixed object. No need for foundation, flexible coupling or sliding base. No lining up difficulties. Unit is driven through any V-belt drive. Stock Taper-Lock Sheaves prescribed for each job. Tri-Matic Overload Release and Backstop available if desired.

Dodge Torque-Arm is America's most complete line of shaft-mounted speed reducers — single and double reduction series—capacities from 1 hp to 60 hp; output speeds of 12 to 365 rpm. Sold from Distributors' stocks.

DODGE MANUFACTURING CORPORATION
3200 Union Street, Mishawaka, Indiana

Call the Transmissioneer, your local Dodge Distributor. He can give you valuable assistance on new, cost-saving methods. Look for his name under "Power Transmission Machinery" in your classified phone book, or write us.

DODGE
of Mishawaka, Ind.

More EQUIPMENT NEWS

Begins on page 152

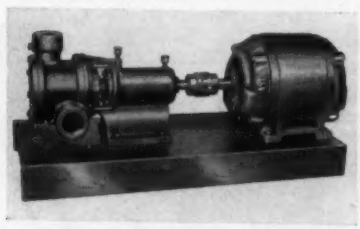
Single meter vacuum gage

933 • Vacuum gage, single meter type, has a range of 0-100 microns Hg full scale. The instrument has a 4-in. indicating meter with knife edge pointer for direct reading on a logarithmic mirror meter scale. Half scale on the dial face is 15 microns.

Manufacturer states that improved design of gage tube, incorporating patented temperature compensated noble metal thermopile, provides greater sensitivity and higher accuracy in low micron range. Noble metal thermopile is housed in nickel plated gage tube, affording freedom from outgassing, system contamination and corrosion. Gage tube reportedly has quick response, and is not damaged by release to atmospheric or positive pressures. Gage tube need not be removed during cleaning of vacuum system.

Instrument operates on 115-volt ac and includes internal voltage regulator to eliminate effects from line voltage variations.

Hastings-Raydist, Inc, Hampton, Va.



Turbine-type process pumps

914 • Single- and double-stage pumps are designed to handle liquified petroleum gases, refrigerants and other non-viscous liquids. They operate at low suction head requirements assuring a positive, non-pulsating flow. Manufacturer states that there is no shaft leakage because minimum pressure is exerted against the mechanical seal through use of built-in pressure relief.

Balance holes on both sides of the impellers equalize pressures in single-stage pumps resulting in balanced hydraulic loads. Impeller loads of two-stage pumps are balanced radically by opposing pressures between stages.

The New York Air Brake Co,
Aurora Pump Division,
4610 Loucks St, Aurora, Ill.

Indicating instruments

925 • A line of high-accuracy portable indicating instruments which are lower in price and require less power from measured circuits are replacing company's *Type P-3* instruments.

The *Type AP-12* (ac/dc) portable standards have an accuracy of 0.25 percent full scale and the matching *Type AP-11* (ac/dc) portable instruments for general testing are accurate to 0.5 percent of full scale, according to manufacturer.

Better scale readability is claimed in all ac rating—permitting more accurate readings over wider portions of the 5.5-in. scale.

All instruments have two spring-mounted pivot bearings, reported to virtually eliminate pivot blunting and cracked jewel bearings. Further maintenance reduction is achieved by simple screw adjustment for full scale sensitivity of ammeters and voltmeters. Request full details.

General Electric Company
Schenectady 5, N. Y.

For more details on these items, use post cards p 139. Identify your request with item number.

All-engine oil cooler

928 • *WIO* oil coolers have application on all types of diesel and gasoline engines, hydraulic equipment, air compressors, machine shop coolant systems and wherever oil must be cooled in a compact unit. They are of non-ferrous construction with brass shell and copper tubes. Operating pressures to 250 psi and operating temperatures to 300 F are available.

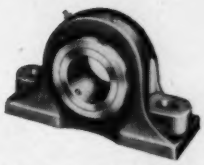
Heat-X, Inc, Brewster, N. Y.

Corrugated aluminum jacketing

940 • Aluminum jacketing for tanks, towers and vessels is available with 1¼ or 2½-in. corrugations. Rigidity is increased by cross crimping the aluminum before

(*Continued on page* 178)

DODGE PRODUCTS you should know



SC and SCM
BALL BEARING
PILLOW BLOCKS

TAPER-LOCK
ALL STEEL
CONVEYOR PULLEYS

DODGE TAKE-UPS

DODGE BULLETINS YOU SHOULD HAVE

1 ROLLING BEARINGS. Load ratings, dimensions and other data on Dodge-Timken and SC and SCM Ball Bearings. Bulletin A638.

1 TAPER-LOCK STEEL CONVEYOR PULLEYS. Construction details, sizes, dimensions. Bulletin D56.

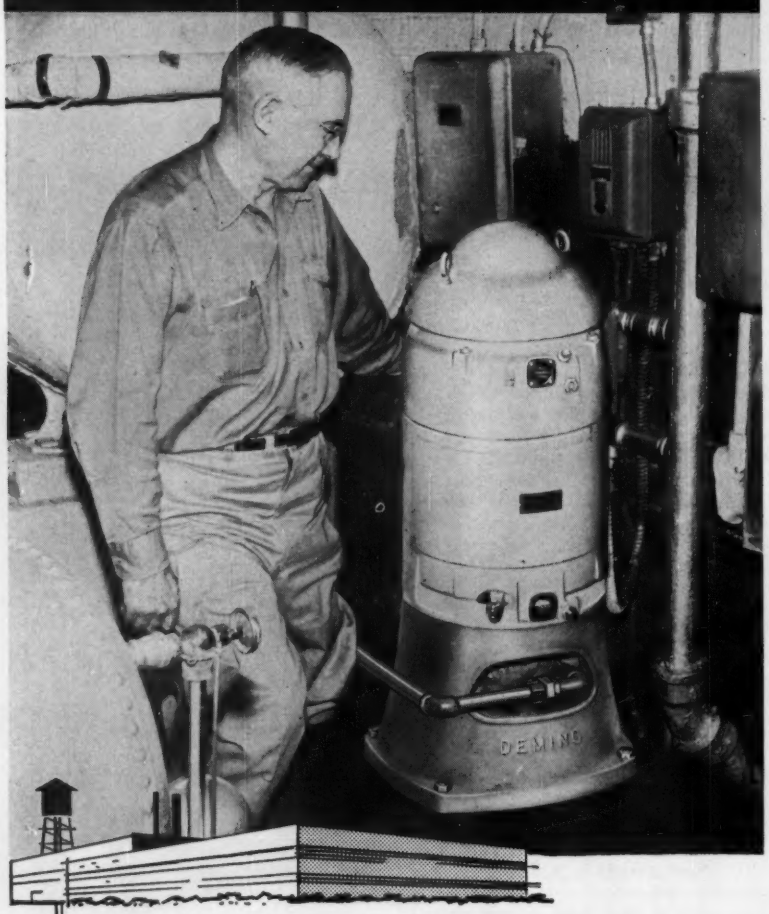
1 DODGE TAKE-UPS. Roller Bearing, Ball Bearing, Babbitted. Bulletin D56.

Write for your copies.

DODGE MANUFACTURING CORPORATION
3200 Union Street • Mishawaka, Indiana

DODGE
of Mishawaka, Ind.

DEMING
TURBINE PUMPS



They Tap a "Gold Mine" Right Under a Plant!

Looking for ways to reduce costs? Don't overlook WATER COSTS! Your company may own a "gold mine" of underground water. Why not use it to reduce WATER COSTS!

Delivering water from deep wells, lakes or streams for factory water supply is one of the biggest uses of DEMING TURBINE PUMPS. *In many cases, these dependable pumping units have cut water costs in half.*

Ask us for free, illustrated Bulletin No. 6700 and the names of Deming Distributors in your area.

THE DEMING COMPANY
547 Broadway • Salem, Ohio

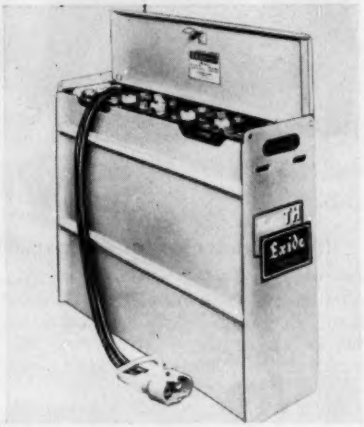
More EQUIPMENT NEWS

Begins on page 152

adding the deep corrugations. Cross crimping reportedly adds up to 97% greater strength over plain corrugated aluminum.

Manufacturer states that a factory-applied moisture barrier added to the jacketing eliminates corrosion from within, provides a virtually permanent jacketing job.

Childers Manufacturing Co,
3620 W 11th St, Houston, Texas



Steel battery trays

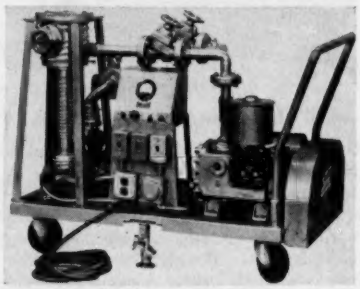
931 • All-steel battery trays for electric-powered hand trucks, conforming to dimensions and practices recently adopted by the Industrial Truck Association, are available for 64 models of motive power batteries.

Trays are classified according to ITA hand truck battery groups 1 through 9, ranging in width from 6⅝ to 18¼ in.

Tray covers are unique in that they can be hinged either at front or back of tray. Built-in stops hold cover open at a maximum of approximately 115 deg.

Exide Industrial Division,
Electric Storage Battery Co,
Philadelphia, Pa.

For more details on these items, use post cards p 159. Identify your request with item number.



Portable pumping system

930 • High-vacuum pumping system is for general laboratory work, pilot plant operations and small scale production applications. It is recommended for use in exhausting 10 to 15 cu ft chambers for vacuum distillation, impregnation, coating, degassing and stress relieving.

Designed to attain absolute pressures as low as 10^{-6}mm hg, this mobile system

They licked a problem—before it happened—with STANODIESEL Oil M

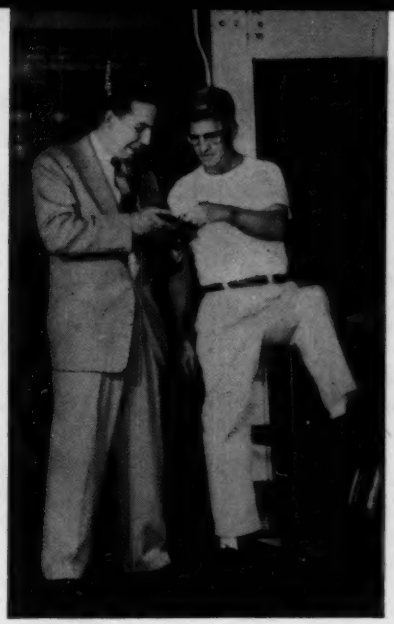
How Sturgis light plant planned ahead to eliminate source of possible power shut down

Sturgis, Michigan, light plant management in 1946 determined that it might be difficult to satisfy all power requirements if the light plant's large engine, or more than one of its small engines, was down. The plant is equipped with 5 engines—four GM 1,600 H.P. and one Busch-Sulzer 2,475 H.P. Plant management rightly figured that one of the keys to the problem was good lubrication. So, in 1946, STANODIESEL Oil M was tested in one General Motors engine.

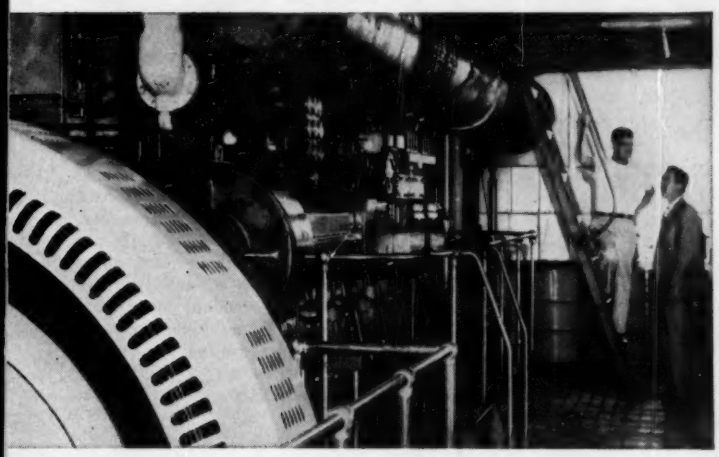
In 1947, based on its performance during the test, all engines were converted to STANODIESEL Oil M. In the nine years since, the plant has never had to shut down power to customers because of engine or oil failure. There have been no wear problems. Engines have stayed clean. There is no ring sticking. Bearing life is exceptional.

STANODIESEL Oil M can give this kind of performance for two big reasons: (1) its highest quality base stock, (2) its additive formula. STANODIESEL Oil M has superior stability. An oxidation inhibitor helps to prevent unwanted increases in oil viscosity. Detergent-dispersant additives keep crankcase, pistons, cylinder walls and other parts clean. An anti-foam agent controls foam.

There's a Standard Oil industrial lubrication specialist near you in any of the 15 Midwest or Rocky Mountain states. Call him for more information about STANODIESEL Oil M. Or write Standard Oil Company, 910 S. Michigan Avenue, Chicago 80, Illinois.



J. J. Threlfall, superintendent and Donald Cripps, Standard Oil lubrication specialist check Don's data book on Sturgis light plant diesels. Don is well qualified as a lubrication specialist. He has been doing this work for nine years. He has an engineering degree from Michigan State University and is a graduate of the Standard Oil Sales Engineering School.



Sturgis, Michigan, light plant has four GM 1,600 H.P. engines and this Busch-Sulzer 2,475 H.P. engine. Engines receive progressive maintenance at 3,500 to 4,000 hours. STANODIESEL Oil M is used in all engines.

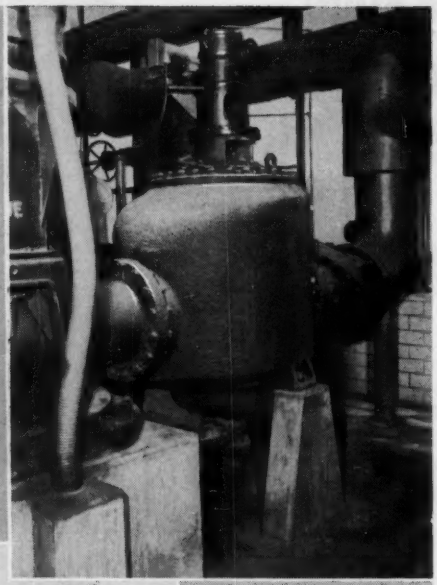
Quick facts about
STANODIESEL Oil M

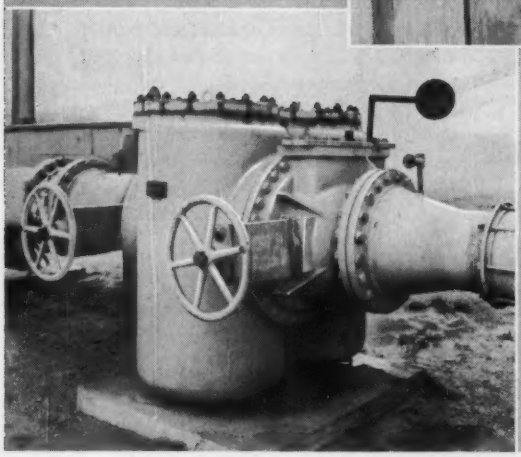
- Keeps crankcase, pistons, cylinder walls clean.
- Combats deposit and wear problems imposed by use of economy fuels.
- Maintains film on difficult to lubricate areas and parts.
- Eliminates spark plug fouling in spark ignited engines and reduces combustion chamber ash deposits in engines burning natural gas, LPG and liquid fuels.
- Eliminates fuel injector and pump sticking caused by deposits on injector barrel and plunger where fuel and lube oil commingle.

STANDARD OIL COMPANY
(Indiana)

STANDARD

Favorites of Power Stations Everywhere!





One of four Elliott 20-in self-cleaning strainers located at discharge side of vertical river-water pumps at a power station.

One of several Elliott twin strainers (installed outdoors) handling cooling water at a power station.

ELLIOTT STRAINERS

Power stations all over the country are utilizing sturdy, dependable Elliott Strainers like these. They provide a continuous liquid flow with no down-time for cleaning. The type "K" strainer (upper right) cleans itself constantly and automatically. The type "A" twin strainer (lower left) offers one compartment for cleaning while the other handles the flow. When your operations call for clean, trouble-free liquids, put an Elliott Strainer on the job—whether the installation is inside or outside. For details on these and other Elliott Strainers, contact your local Elliott representative or write Elliott Company, Accessories Dept., Jeannette, Pa.

AS-1

ELLIOTT Company

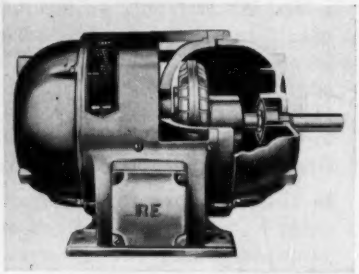
STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

More EQUIPMENT NEWS

Begins on page 152

uses a fractionating 4-in. diffusion pump connected to a 15-cfm two-stage roughing and backing mechanical vacuum pump. All components including the electrical control panel are mounted on a base fitted with two fixed and two swivel wheels, caster lock and pull handle. Service connections required are a single-phase 60-cycle 110/115-volt ac outlet and a source of cooling water. Request full details.

Kinney Mfg Div, The New York Air Brake Co, Boston, Mass.



Internal dry-fluid coupling

924 • *Flexible-shaft* motor uses steel shot instead of a true fluid coupling. The coupling is mounted inside motor's frame and the entire unit is supplied as a single-frame power package.

Operating principle of the dry-fluid coupling is based on centrifugal force throwing the steel shot to the perimeter of the housing. The housing, in turn, is keyed to the load and accelerates as the rotor gradually becomes imbedded in the tightly-packed shot.

Motors are produced in ratings from ½ through 15 hp. Request full details.

Reuland Electric Co, Alhambra, Calif.

For more details on these items, use post cards p 159. Identify your request with item number.

Seamless bronze tubing

934 • Eight-in. id seamless corrugated tubing with standard 150-lb bronze flanges is suitable for conveying steam, water, air, etc and for transmitting vacuum. Principal characteristics of the corrugated tubing are: outside diameter, 10 in.; thickness of metal, 0.080 in.; number of corrugations, 12 per ft; approximate weight, 20 lb per ft; maximum length without joint, about 8 ft. End connections of any type are available, such as standard or special flanges, pipe nipples, weld ends, etc. If internal pressures are involved, one or more metallic braid jackets are provided. Safe working pressure for one braid is about 100 psi.

Principal applications: vibration eliminators, expansion and contraction compensators, misalignment equalizers, etc. Standard stock sizes of seamless, flexible, bronze tubing are available down to 1/16-in. inside diameter.

Further information in bulletin 955, available on request to manufacturer.

Seamlax Co, Inc, 4123 24th St, Long Island City 1, N. Y.

PACKAGED TOWER POWER

"Power comes in one piece" on a Marley cooling tower—a completely integrated unit that consists of motor, drive shaft, couplings, Geareducer* and fan hub, assembled and permanently aligned on a rugged unitized steel support.

Every component of this packaged power unit (except the motor of your choice) is Marley-designed and manufactured exclusively and specifically for cooling tower use. Each is engineered for individual mechanical excellence and for functional integration into the complete assembly. All are backed by a single responsibility for dependable performance and economical maintenance, and that backing is the Marley guarantee.

These units are standard for all Marley industrial towers and, together with Marley multi-blade aluminum fans, are available for modernization of towers of any make. Installing the pre-assembled Marley power package for replacement service reduces shut-down time by days.

For detailed information on "packaged power" for new or existing towers, call the Marley sales engineer in any of 55 major cities.

*Reg. Trademark

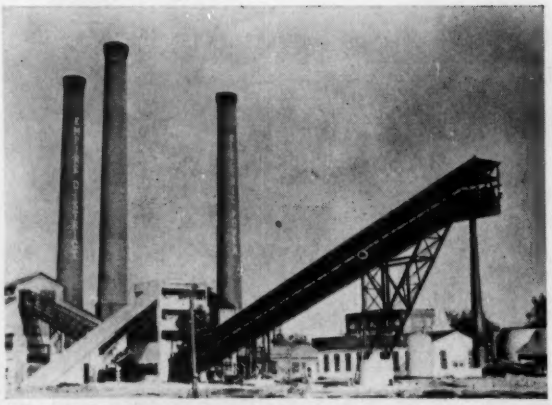
The Marley Company

Kansas City, Missouri

MARLEY

Founder-Member Cooling Tower Institute

EARN EXTRA PROFITS IN SAVINGS



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My biggest boner

This is the story of two outside foremen who both worked at a smokeless powder plant during the war. Plant had many buildings, spread over a large area. Besides, the power department's powerhouse, boilers and turbine, there were several outlying power buildings. Some were: river pumping station, filter plant, air-compressor plant and the hydraulic and refrigeration (H & R) plant. The two foremen had charge of these outside buildings.

H & R building housed six hydraulic pumps of 3600 psi, also six ammonia compressors driven by synchronous motors. These machines served an area were service had to keep going.

To appreciate this boner, readers must know my background compared to Smith's—the other outside foreman. I had nine years in one power plant, worked my way up to assistant chief engineer there. At war's outbreak, I worked in a smokeless power plant as a switchboard operator, boiler operator and then as outside foreman.

Now Smith had been an oil-field mechanic until he worked as an operator in the H & R building of this plant. From there, he was promoted to outside foreman—and we became rivals.

I was working the midnight shift one night when an electrical storm hit. It was near shift-change time in the morning. Lightning caused a surge on the power lines and all the machines in the H & R building stopped. Just then I drove up in my truck and hurried inside to help the operator restore service to the area. Directing him to start the hydraulic pumps, I started to get the ammonia compressors running. Already I had visions of a record return to service. But here is where the hitch came in. As soon as I started one compressor and went to the next—the first synchronous motor would kick off. I thought there was too much load on the motor, so I closed the suction valve and tried again, working my way down the line of compressors. Each motor ran for a minute or so, then kicked off.

About this time in walks Smith, my relief foreman. He said, "In trouble? I'll help you." He goes in the back room, starts the exciters, which had also stopped during the power interruption, and away we went. All the compressors started and ran OK. We got back to normal in short order. But was my face red! And I had fancied myself well up on the electrical end of the power game.

H C Pooley *Wilmington, Del*

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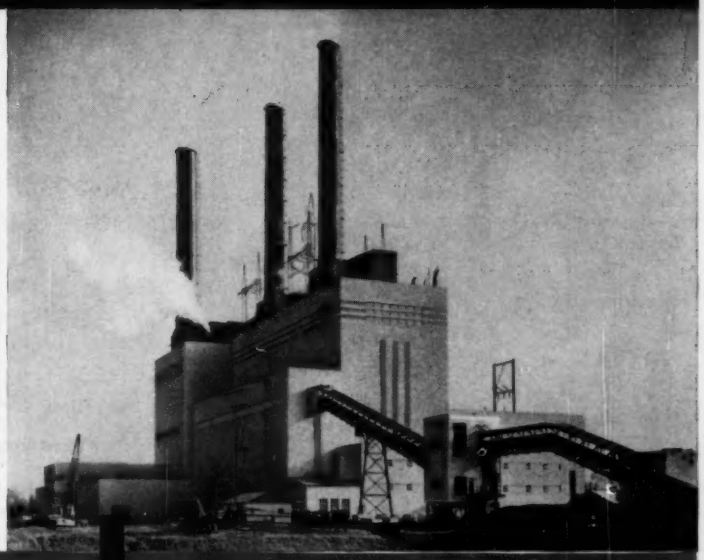

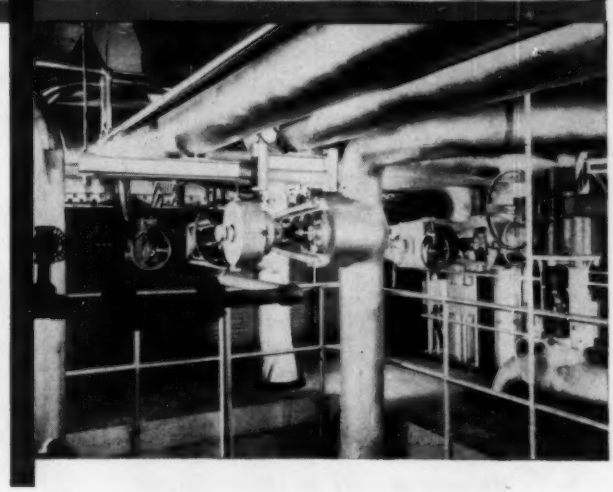

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MARMADUKE

Continued from page 138

the cantankerous old boy was about to sound off. Marmy revved up his induced-draft fan and sent a cloud of smoke toward the ceiling. Then he blasted away.

"Back in World War II, I was stationed at a repair base in Genoa, Italy," he roared. "That shipyard had been taken over by our Navy to repair the many Allied ships damaged by the heavy air and submarine attacks after the invasion of Italy.

"Because so many ships came limping into that yard, there were plenty of tough problems. Some weren't casualties—they were merely fouled-up ships that had been turned out like sardine cans by green help back in the States. Others were ships that had taken a heavy beating but had to be kept running by some jury-rig method before getting a thorough overhaul in dry dock. That's where I came in.

"One evening, my boys and I were making our usual rounds to hot spots like the Casa Suprema, the Pension 900 and other high-class joints. At the Suprema I ran into a former shipmate, Carl Drymeyer. Carl was in port as chief engineer aboard the SS *Sea Porpoise*. She had struck a floating mine off Gibraltar and came in leaking like a sieve from sprung plates. Carl said her ballast and bilge pumps had been running full speed to keep her afloat. But besides the sprung plates, one of her boiler's casings was bulged out, while the other was caved in.

"The *Porpoise* was a C-3-type ship with D-type boilers of 565 psi at 735 F. Her hull plates and boilers had been given a quick once-over, Carl told us. But he squawked that she had never built up her vacuum to design rating on her main turbine since being built. That got me to thinking. We batted the problem around during some heavy technical discussions that evening at the Suprema. On my way back to the station at 4 am, I promised Carl I'd go aboard to see what I could do for him.

"Next morning, I boarded the *Porpoise*. Some of the yard big shots were down in the engine room when I hit the floor plates. Carl had a few blueprints on the log desk and the brass were busy trying to solve that vacuum problem. But I just walked around, getting my bearings.

"I saw that the boilers had an internal desuperheater line to knock down the 735-F steam temperature for auxiliary use. Steam for the air ejectors that Carl had squawked about came off a Christmas tree of reducing valves above the boilers. I'll bet marine engineers who sailed on those tubs

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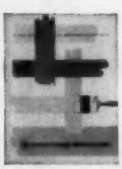

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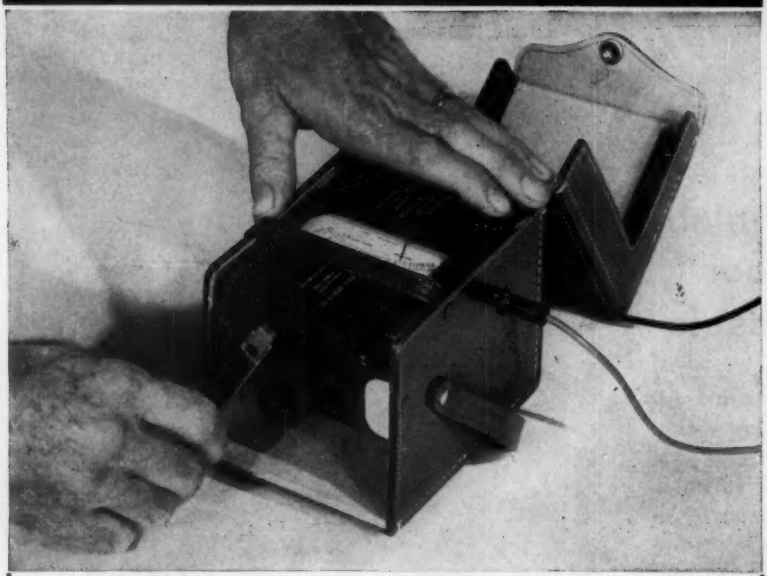
BIDDLE *Instrument News*



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MARMADUKE

Continued from page 184

still wake up suddenly in a sweat in the middle of the night from that nightmare of piping confusion. After the desuperheated steam got through a few reductions, it finally came out at 160 psi at the air ejectors.

"I was told that the ejectors had the full 160 psi, but they still didn't build up the 28.5 inches of vacuum. About 26 inches was the best they would do. That raised fuel consumption about 12 percent, lowered speed.

"After I got the vacuum system down pat, I went over to the log desk to see what the brass were recommending for a solution. A four-striper suggested raising the steam pressure to the ejector—'temporarily, of course.' I asked Carl if his ejector strainer and nozzles were in good shape. He assured me they were. Then I asked if his steam gage showed the right pressure. He said they had been tested and were OK—added they had been slopping shellac around every place where air could leak into the vacuum side.

"'That leaves only one thing as far as I can see,' I answered.

"'What's that?' asked the four-striper, eager to sink his teeth into something.

"'Steam quality,' I answered.

"'Steam quality, hell,' he echoed. 'I've been aboard a dozen of these C-3's and they're all hooked up the same way. None of the others has trouble with steam quality. Why should this one?'

"'That's what I want to find out,' I answered. 'Carl, how about starting up your circulator and getting vacuum up on the turbine? I want to try something,' I told him.

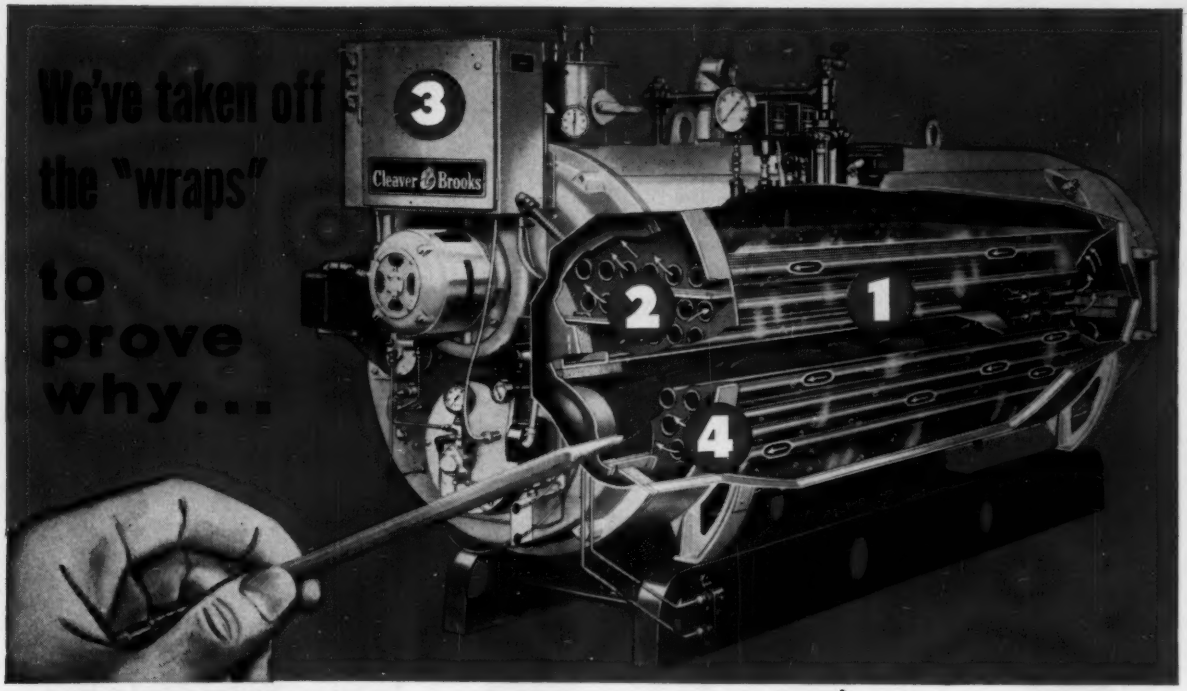
"Before long, his chief machinist had his lube-oil pump and circulator running, had gland steam on the turbine and the vacuum came up gradually. But the needle stuck at 26 inches. By that time I had an audience of yard men and ship's engine-room personnel.

"'OK,' I said. 'Now shut off the steam from the starboard boiler so the air ejector is fed only from the port boiler.' A water tender closed the valve. I watched the vacuum gage, but she didn't budge.

"'Now open that valve and close the valve to the port boiler,' I said. Soon as that valve was closed, the vacuum started climbing slowly. Everyone crowded around the vacuum gage. She finally stopped at 28.5 inches, where she belonged.

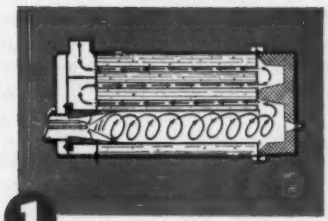
"'Holy mackerel, Marmy,' yelled Carl. 'That's the first time that vacuum has been up there since this ship was built.'

"'You struck something, Mr Sur-

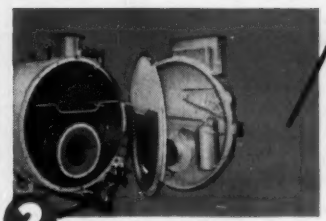


CB is America's most modern boiler

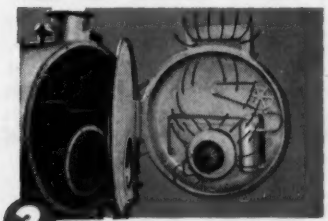
unmatched in performance quiet operation low-maintenance



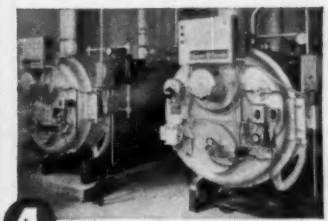
1 **Four-pass design with forced draft — Proved the most efficient combination to transmit greatest percentage of heat to boiler water. Blower provides cool, clean air in required density and volume for efficient fuel combustion — lowers fuel costs.**



2 **Hinged doors front and rear — Expose tubes for quick inspection or cleaning. Operating equipment and refractory stays intact. Cuts routine maintenance from hours to minutes. Doors are gasketed with preformed asbestos to be seal-tight.**



3 **Caseless fan keeps operation "hospital quiet" — Air is drawn into a large plenum chamber which confines and deadens air noises. Even at peak loads, CB is well within requirements for low sound levels where this is a factor.**



4 **Automatic controls are centralized for convenience, efficiency and safety — Air is metered with oil (or gas) in proper ratios to economize on fuel. Electronic flame failure control is standard equipment.**

CB boiler's remarkable performance in hundreds of applications has proved an "eye-opener" wherever installed. Take a minute's time and see why.

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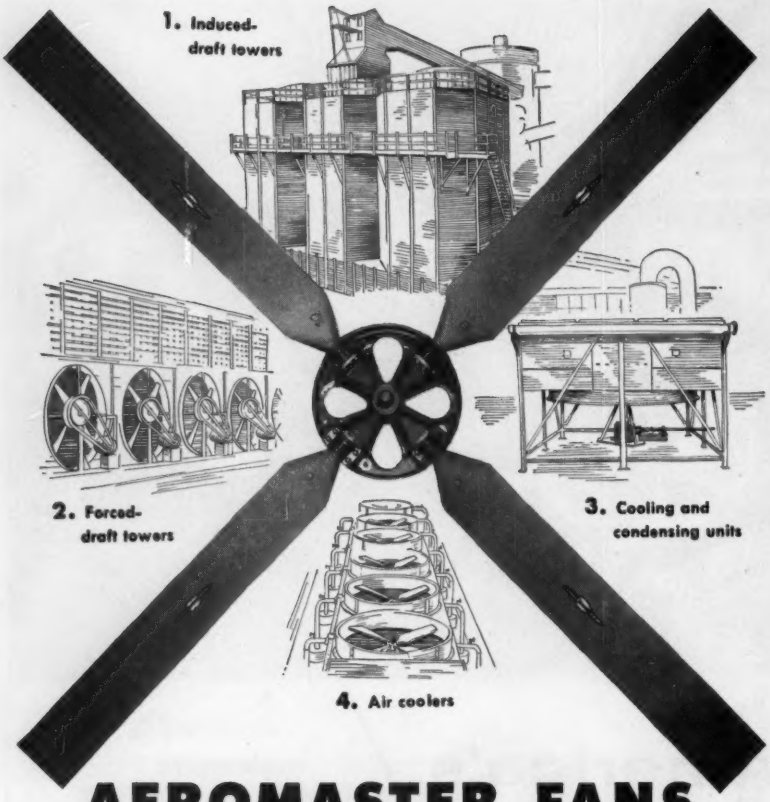

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MARMADUKE

Continued from page 186

faceblow,' said the four-striper good-naturedly. 'But I still don't know what's going on.'

"'Well, I don't know what's happened yet, myself,' I answered, 'but I will. Now cut out the starboard boiler, cool her down and dump her,' I told Carl. 'After the steam drum is opened, call me. I'll be up topside in the wardroom, stowing away some fuel.'

"'Good idea,' said the four-striper. 'I'll join you. I need some ballast to get me out of this fog so I can follow you.' We all went topside to the wardroom to ballast our tanks and have a smoke.

"After lunch, the chief machinist came up and said the boiler was cooled down with one of her steam-drum manhole plates removed. So we all went below again.

"'OK,' I told Carl. 'Have one of your boilermakers go inside and check the desuperheater lines for loose connections.' We stood around on the drum grating while this check was made.

"'Hey, Chief. Look at this,' called the boilermaker from inside the drum in a few minutes. 'The nuts on this flange are all loose, there's about an eighth-inch opening and there isn't even a gasket here.'

"'That's your answer,' I said to Carl. 'That opening picked up moisture from the water in the drum. And that knocked down the quality of your steam so you didn't get full value. That's why you had low vacuum all this time.'

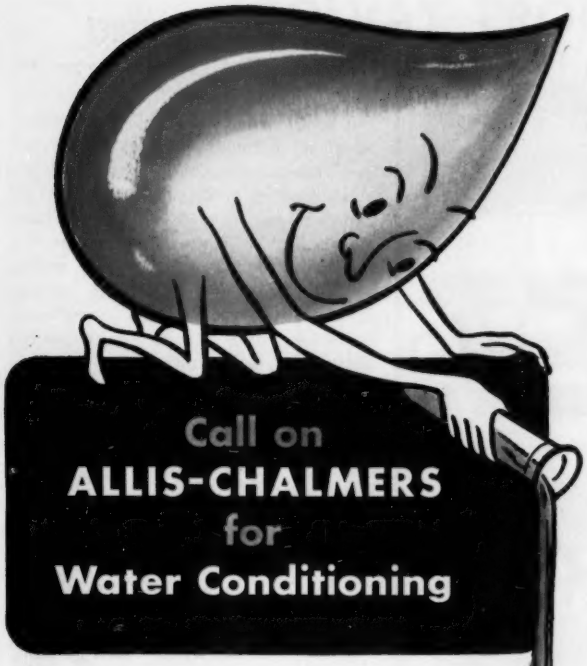
"Carl slapped me on the back. He was as tickled as a sailor going ashore in a foreign port after a long voyage. 'You know, Marmy,' he said, 'that's the last place I would have looked. All the time I've been blaming the throat area of the ejectors, or something. Now we can really make knots.'

"'And I'd never think of finding lost vacuum by cutting out a boiler,' said the four-striper, pumping my hand. "That evening we ended up at the Casa Suprema again. Only this time the boys wouldn't let me spend a cent."—*SME*

THE ALIQUIPPA RANG A BELL

That river story in Sept '55 brought back memories. I fired on the *Aliquippa* in 1921. The Chief was most interesting and I well remember the "doctor" feed pump that Marmy had trouble with in his story. The Chief was one swell guy—so I'm sure you can understand how deeply I felt when reading Marmy's experience.

R FONTAINE *Kenmore, N. Y.*



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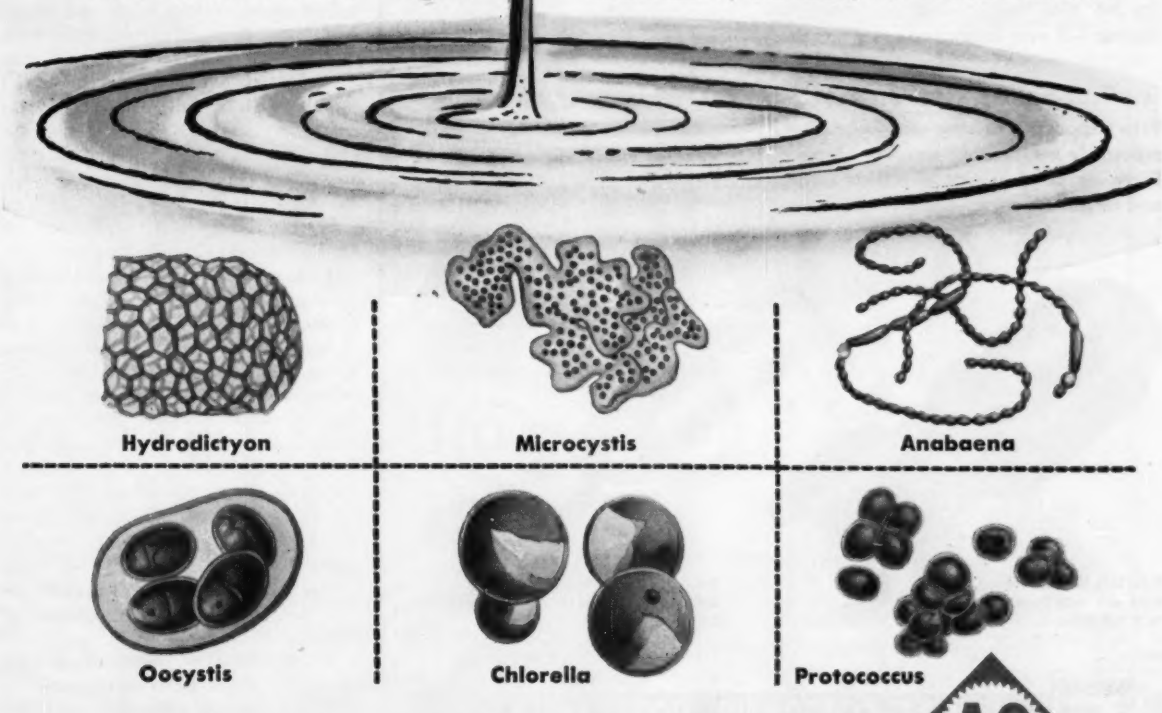

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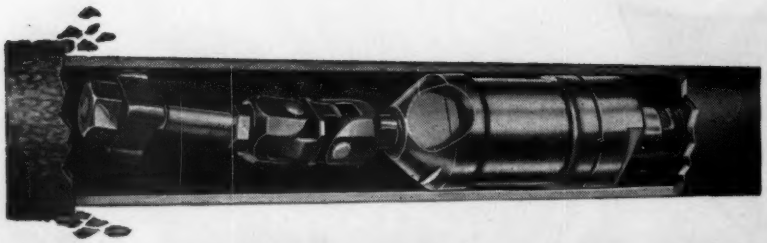

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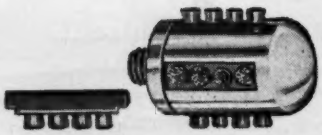

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MAINTENANCE CONTROL

Continued from page 105

But problem isn't that jobs don't come up at set periods. Multiply all factors involved, and you come up with a large number of operations to schedule. Stalcup wouldn't even try to guess how many. But he doesn't have to, for his punched cards keep the jobs under control. Each Friday evening, sorting drops out work to be done, either over the weekend (if they're production-interrupting) or the following week.

Stalcup points out the psychological effect on his maintenance men. He told us: "Neglect and carelessness are rare. Most maintenance men love machinery and give it the right care. But without a good system, a man often leaves a routine job to handle an 'emergency.' While he may even make a note to remind himself to return to the interrupted work next day, even the best of us forget!

"With a formal system such as ours, an assigned mechanic does a specific job a certain date. That man is handed the work order. He's going to do it *that* day, or report back *why* he couldn't. Work gets done and it takes only 'spot' supervision on my part to make sure all's well. Prior to our key-sort system, maintenance was one of my greatest worries. It also cost me a lot of time in supervision."

Emergency repairs bring up another advantage of well-scheduled maintenance work. A high percentage of such sudden headaches is normal to today's complex operations. It's like the days before screens and DDT when our grandmothers used to preach that the good Lord sent pesky houseflies to test our mettle!

But up-to-date plant engineers regard work stoppage, caused by emergencies, with the same horror a modern housewife looks on a single fly in her home. S W McMahan, Jackson's master mechanic, reports: "I can't remember a single motor that quit in the last two years from lack of proper service." That's some statement when you remember Jackson Mills' several-hundred electric motors.

But it's also a typical result of good scheduling. In another plant 75% of all maintenance labor was applied against operations classified as emergency. This is a parts plant—and the firm was having delivery problems because of work stoppage.

Six months after installing the card system, emergency factor dropped to 25%. At last report, even that figure was going down hill. But until the condition became impossible, it had been accepted. Above results proved there was a pattern of planning to pre-

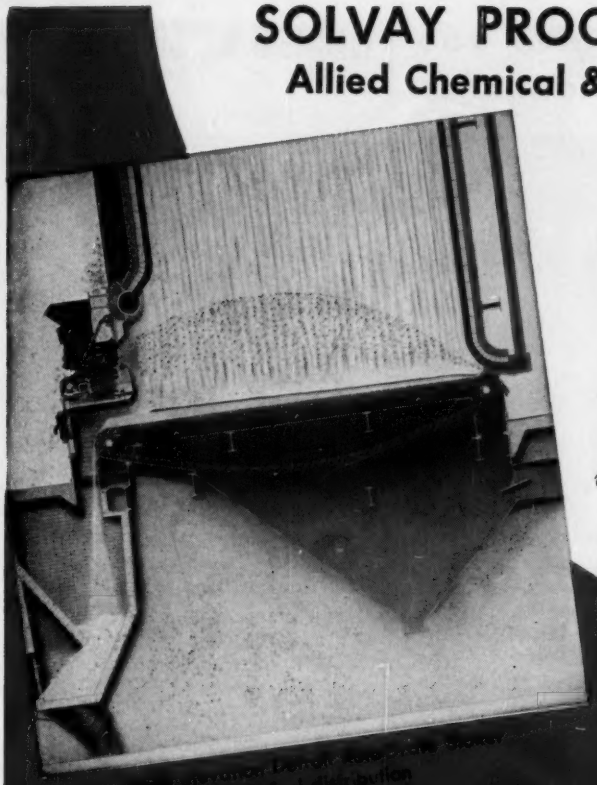
SOLVAY PROCESS DIVISION
Allied Chemical & Dye Corporation

USES DETROIT ROTOGRATE STOKERS

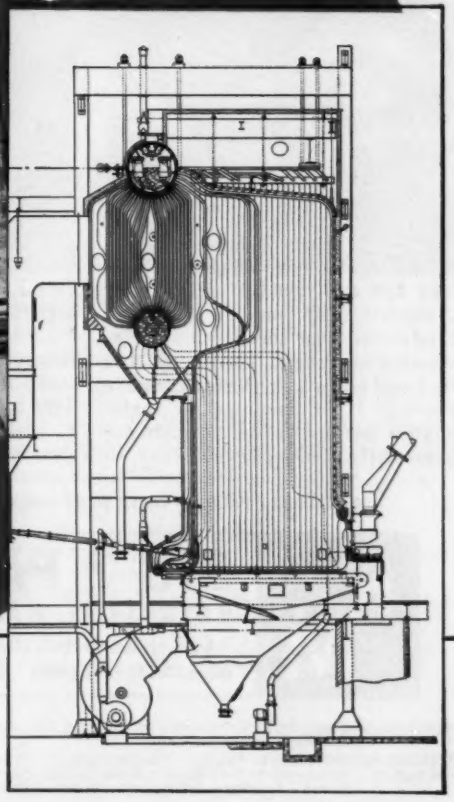
at Moundsville to Burn West Virginia Coal

Detroit RotoGrate is a modern spreader stoker with grates that move slowly forward, discharging ash at the front. It will burn any type of Bituminous coal or Lignite and many types of combustible refuse with high efficiency. Handles rapidly fluctuating loads. Produces more capacity per square foot of grate area. Precise control of fuel feed with grate speed and air supply provides smokeless operation.

There is a size and type of Detroit Stoker for every industrial need.



Detroit RotoGrate Stoker with Babcock and Wilcox two drum Stirling boilers in Moundsville Plant



Moundsville, West Virginia, (Marshall County) Plant, Solvay Process Division, Allied Chemical & Dye Corporation.

Ask for latest Bulletin.

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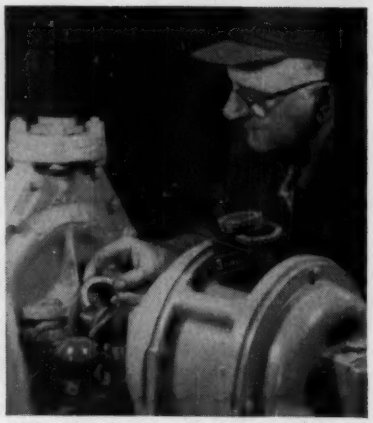
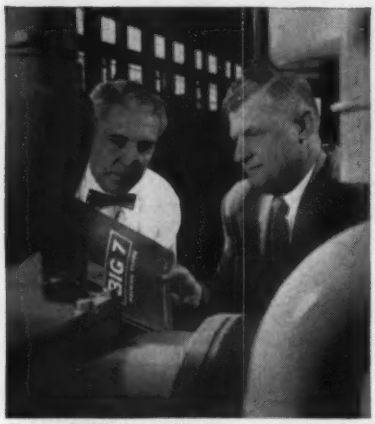
R/M's Big 7 Packing Types give you dependable custom-built performance

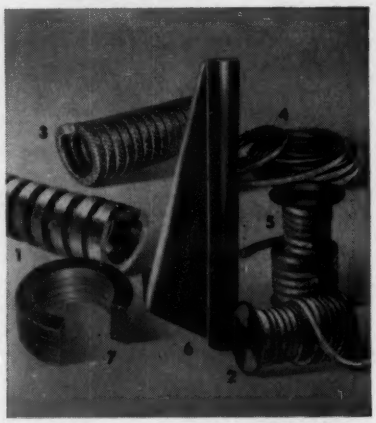
When you standardize on R/M's Big 7, you are sure of getting superlative, custom-built performance that will greatly reduce your maintenance costs and downtime. You can set up a schedule of preventive rather than corrective maintenance. Most plants require only 3 or 4 types.



R/M's "Teflon"* packings, Type 5, for example, are unsurpassed for use on chemical pumps and valve stems. Carefully engineered and custom-built for their applications, they are lasting longer in service and lengthening the life of the equipment they are used on.



Your R/M distributor will be glad to explain how you can profit by standardizing on the Big 7. Besides reducing costs and downtime, the Big 7 will lower inventories, simplify ordering. R/M packings for maintenance are sold only through authorized R/M distributors.



Type 1, for pumps, valves; **Type 2,** for high temperature valve stems, expansion joints; **Type 3,** for high speed rotary air compressors; **Type 4,** for corrosives, acids, viscous materials; **Type 5,** "Teflon" for chemicals; **Type 6,** gasket materials; **Type 7,** for hydraulic and pneumatic equipment.

*Du Pont trademark

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MAINTENANCE CONTROL

Continued from page 190

vent emergencies. But it took sorting and cross analysis of causes to establish a sound program.

You can't completely ignore phases of maintenance other than scheduling. Without details, let's hint at a few: (1) Using manpower by crafts efficiently. (2) Assigning master electrician to trace a chronic overload. (3) Using an apprentice to replace a fuse. (4) An "inventory" of manpower hours by crafts. (5) Can your boys handle a department shift, or should an outside contractor be hired? A surprising number of plants know norms on maintenance jobs. That is, they know a certain mechanic can do a given job in, say, 1.2 hours. If he doesn't job is checked.

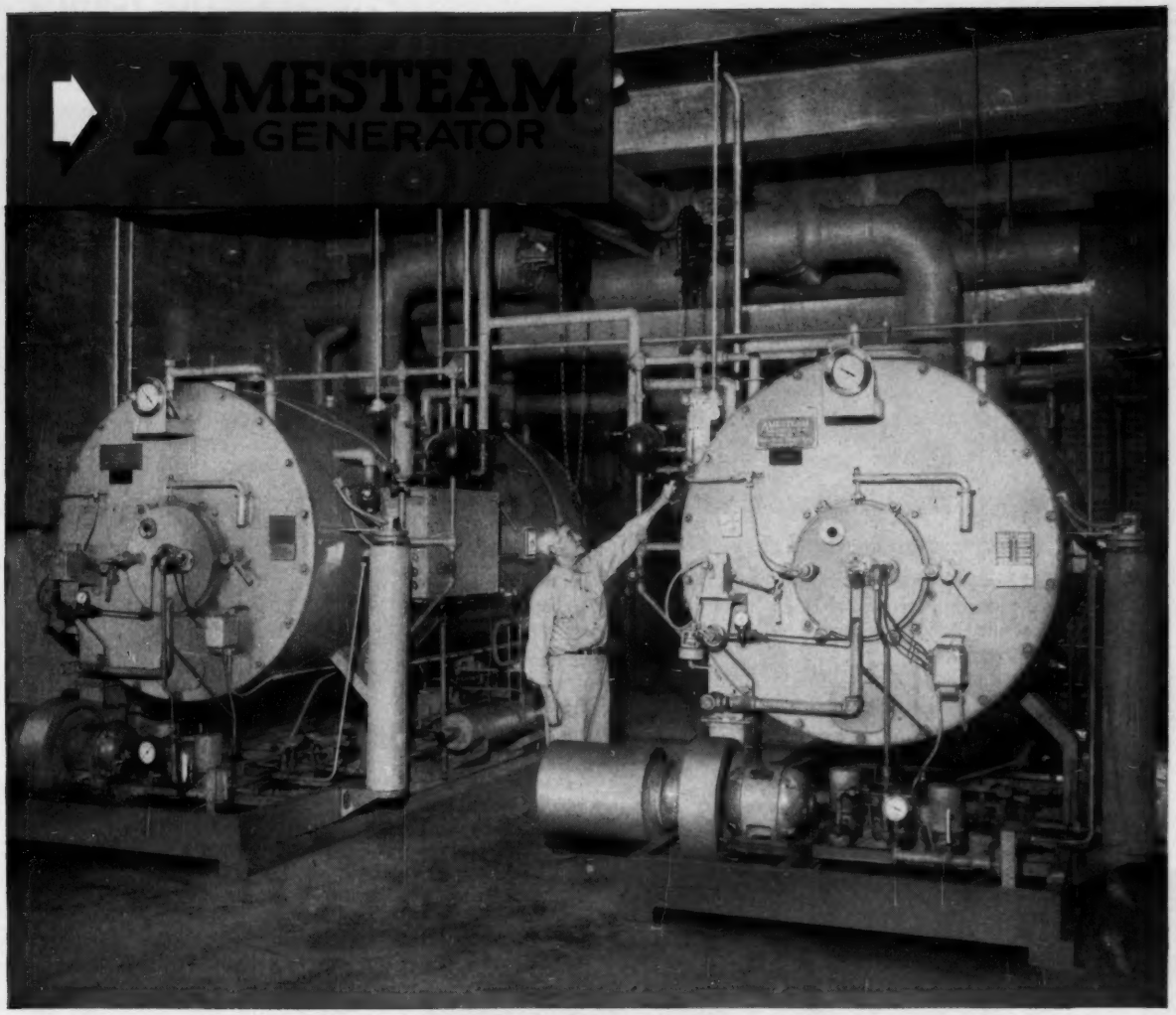
This directs attention to good costing. In some plants, maintenance is a major factor of cost. Many firms are so inclusive in defining "maintenance" that almost all indirect labor is so classified.

And that leads to a pet "soap box" subject of mine. Indirect labor can be controlled! Just because there's no visual daily frequency is no proof a pattern to indirect labor doesn't exist. Accurate historical data will highlight it. Hundreds of successful maintenance-control systems (as just one example of indirect labor) have proved that's so. It's also true of other indirect labor distributed to accounts other than maintenance.

There's no standard "cure-all"—although there are common fundamentals. For instance, Jackson Mills No. 1 doesn't practice all the phases we hinted at above. That's because experience has taught this South Carolina firm it isn't needed. But Jackson knows that by experience—not by judging the "hog on the hoof." Each plant is an individual case, depending on factors of plant layout, personnel, equipment, location as it applies to craft availability. You name your own!

But this is true: Maintenance control must start with scheduling—getting the job done (by the right man) when it should be done. That's easy, and it pays off in peace of mind, increased capacity of management and supervisors for other duties. Don't ignore good maintenance control. Your competitor is either practicing or planning it!

Scanlan-McMahon Associates, Inc, a new firm of consulting engineers, has established an office in Cleveland, Ohio. The new firm plans to center its activities in the field of industrial steam power plants. The main office is 18724 Scottsdale Boulevard, Shaker Heights 22, Ohio.



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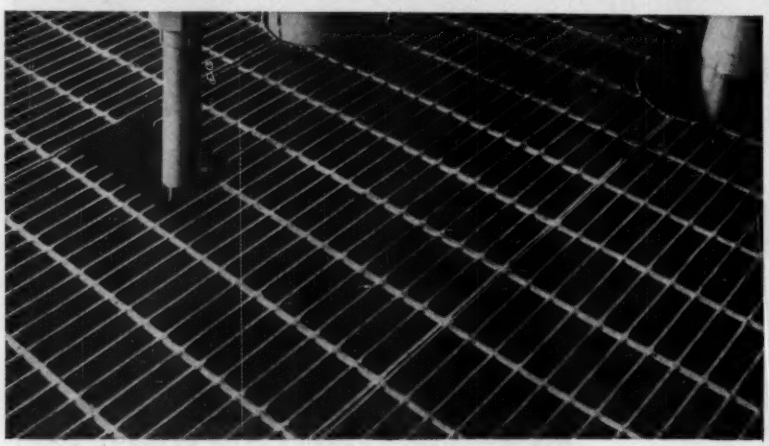

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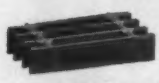

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GAS BEHAVIOR

Continued from page 97

an absolutely uniform bore, so we're sure of equal volumes between graduation marks.

First, we pour in mercury till equal amounts stand in both legs and we have trapped exactly four volumes of air in the closed leg, Fig. 5*a*. We keep water running over the leg with the trapped gas so its temperature stays constant at T_a.

On the day of our experiment, barometric pressure = 30.00 in. Hg abs. So we have four volumes of air trapped in the closed leg at an absolute pressure of 30 in. Hg abs.

Next, we pour mercury into the open leg until the air volume reduces to three units. We do this slowly so the cooling water can keep the gas at exactly T_a temperature. For this volume we find the gas is under 10-in.-Hg gage pressure, Fig. 5*b*. This, of course, is 30 + 10 = 40-in.-Hg abs pressure.

In *c* we have poured in more mercury to reduce air volume to two units and find it under 30-in.-Hg gage pressure or 30 + 30 = 60 in. Hg abs. Finally, in *d* we pour in more mercury to reduce the gas volume to one unit, and find the pressure is now 90 in. Hg gage, or 90 + 30 = 120 in. Hg abs. Before taking the measurements we have made sure each time that the trapped gas was at the temperature T_a.

Now let's list corresponding volumes and absolute pressures and then multiply them together:

Pressure, in Hg abs	*Relative volume*	$P \times V$
30	4	120
40	3	120
60	2	120
120	1	120

This shows that the product of pressure and volume stays constant for all conditions. So we can write this relation, known as Boyle's law, as:

$$P \times V = C$$

Measuring units for these quantities can be any convenient ones:

P = gas pressure, psfa, psia, in. Hg abs
V = gas volume, cu ft
C = constant, usually different for each gas.

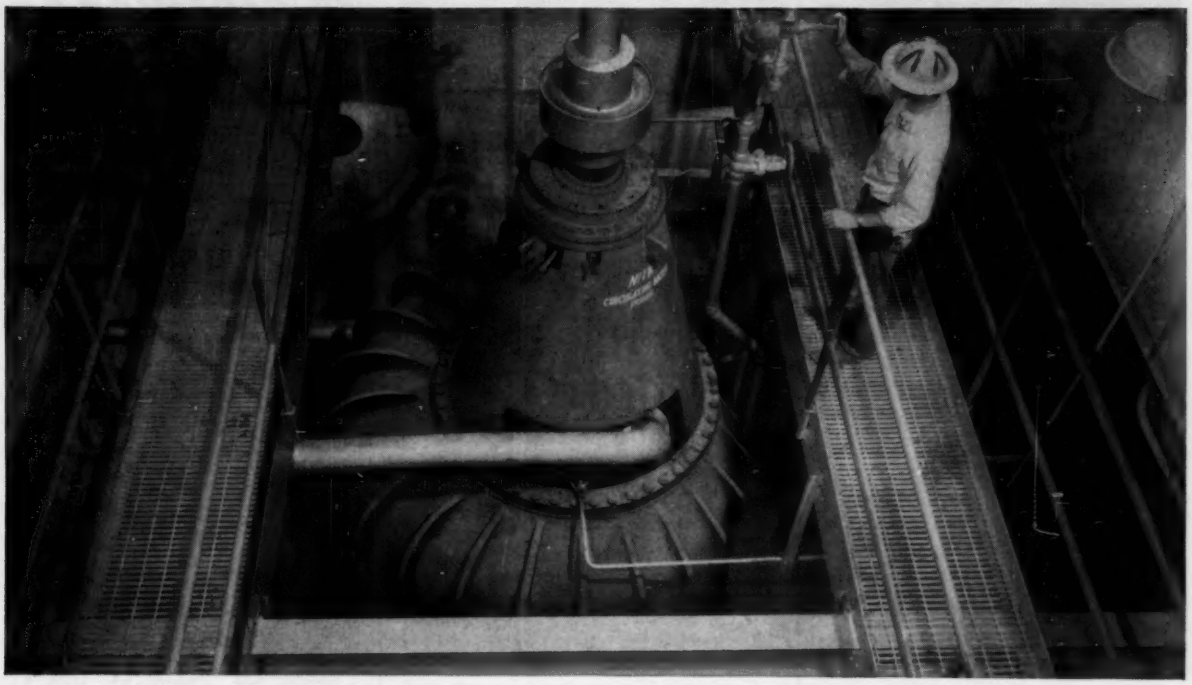
Note that the gas temperature must stay constant for this law to hold.

Curves are useful tools in thermo, so let's plot our data for Fig. 5 in Fig. 6. This shows that as volume shrinks the pressure rises, gradually at first, then more and more rapidly. Starting from any point, doubling the volume halves the pressure; in reverse, halving the volume doubles the pressure.

Molecular action. We can explain the relations in Fig. 6 by studying what

Allis-Chalmers

PUMPS Meet Power Plant Requirements



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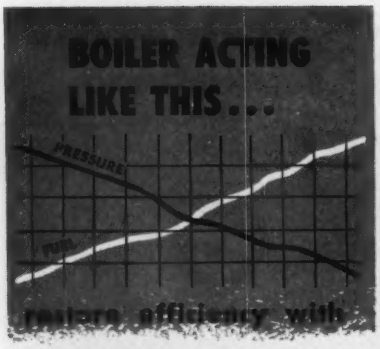

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GAS BEHAVIOR

Continued from page 194

must happen to the molecules of the gas. The number of molecules in this mass of gas stays constant, but the space they move around in varies. This affects the number of collisions of the molecules *per unit area* of the enclosing container.

Actually the individual molecules move in haphazard fashion, but to simplify analysis we can assume that one portion of the total molecules bounce up and down vertically to produce pressure on the top and bottom of the container, Fig. 7*a*. The other molecules bounce back and forth, horizontally to produce exactly the same pressure on the side walls of the container.

When the volume doubles, Fig. 7*b*, the molecules traveling vertically have twice the distance to go; so they now collide half as often with the top and bottom of the cylinder, dropping the pressure in half. On the other hand, those molecules traveling horizontally now cover double the wall area, so the same number of collisions produce half the pressure ($P = F/A$). Since the temperature stays constant the molecular speeds stay constant.

Pressure-volume relations. Whenever we deal with a *given weight* of a gas at constant temperature we can use Boyle's law to figure related pressures and volumes. We do this by the following method: When the gas is in state *1*, we can write:

$$P_1V_1 = C$$

For state 2:

$$P_2V_2 = C$$

Since C is the same for all states, we then write:

$$P_1V_1 = P_2V_2$$

So if we know pressure and volume of a gas at one state, we don't even have to figure C to find what they would be at another state, provided the temperature doesn't change.

Example: We have trapped 10 cu ft of air in a cylinder with a movable tight piston, at atmospheric pressure of 14.7 psia. What will its pressure be when the piston is moved to reduce volume to 1 cu ft and the temperature remains the same?

Let's substitute these quantities in our last equation:

$14.7 \times 10 = P_2 \times 1$

$P_2 = 14.7 \times 10/1 = 147$ psia when the volume shrinks to 1 cu ft.

Example: What volume must be provided in the above cylinder to reduce the air pressure to 3 psia?

Again, let's use our equation and substitute:

$14.7 \times 10 = 3 \times V_2$

$V_2 = 14.7 \times 10/3 = 49$ cu ft to reduce pressure to 3 psia.

Most gases follow Boyle's law quite

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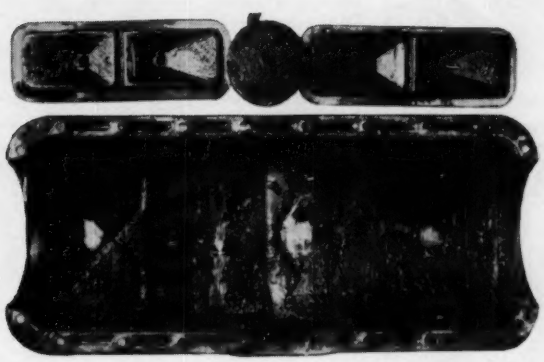

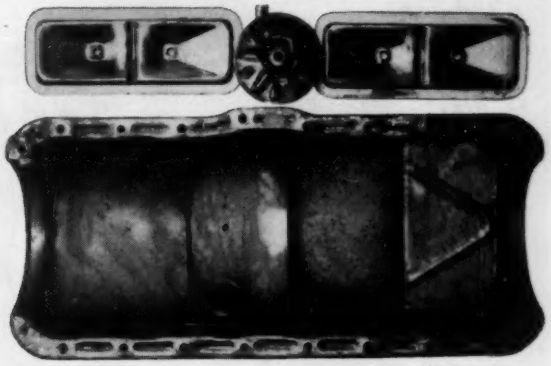

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GAS BEHAVIOR

Continued from page 196

closely over fairly wide ranges of pressure. Very careful measurements show they all deviate some small amount. At very high pressures and temperatures they may disagree quite a bit. This is probably caused by the larger mutual attractive forces that the gas molecules exert on each other when they are crowded together. For most engineering purposes we can use Boyle's law with confidence. It is accurate enough to give the answers we need to solve many practical problems.

Next part will cover Charles' law of gases, the meaning of absolute temperature and the universal gas equation—in a forthcoming issue.

FUEL ADDITIVES

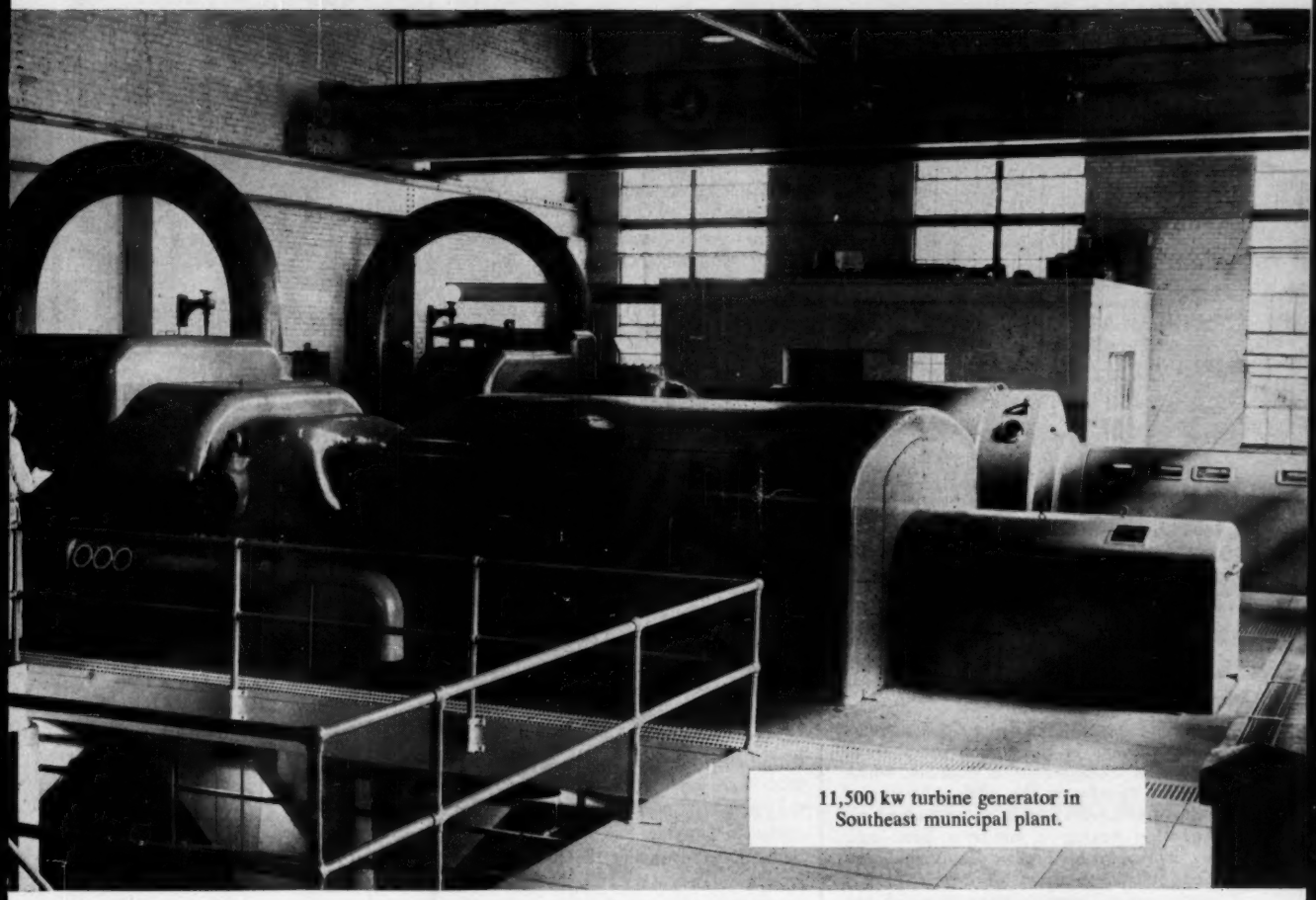
Continued from page 109

—the first is a purifier and the second a clarifier. Since provision exists for removal of water, it does not make any particular difference, *under usual conditions*, whether surface-active ingredients incorporated in the additive are of an emulsifying or demulsifying nature. But an additive that allows demulsification and still retains the ability to prevent and disperse sludge as well as overcome corrosion in the fuel-oil system—can be formulated.

An increasing practice in diesels is water-washing the fuel to dissolve impurities. Water and water-soluble impurities are then removed at the centrifuge. If it is difficult to remove water here, a special demulsifying additive may break persistent, troublesome emulsions.

There is a thin line between emulsifying and demulsifying additives. Often treatments that function well as emulsifying agents work equally well as demulsifiers under other conditions. An emulsion phase reversal is possible, especially where water contamination is heavy. So it is important to study conditions carefully in terms of previous experience. The trend to pretreated light diesel oils is toward additives that have neither an emulsifying nor a demulsifying action.

Combustion deposits. Two major groups of deposits are caused by combustion: (1) those that are organic in nature and consist of true soot or combustible carbon products, and (2) mineral residues that have ash or slag characteristics, depending on temperature. Mineral residues come from ash and sulfur content of the fuel and from inorganic contaminants, which might come from any sea water pres-



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T-63

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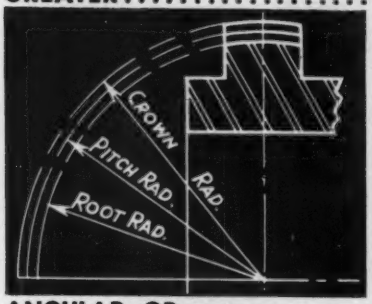

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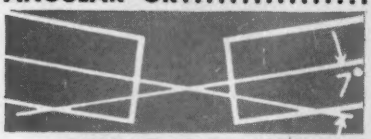
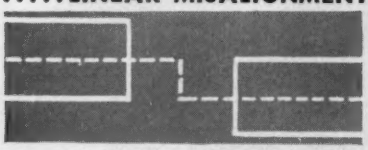


.....LINEAR MISALIGNMENT



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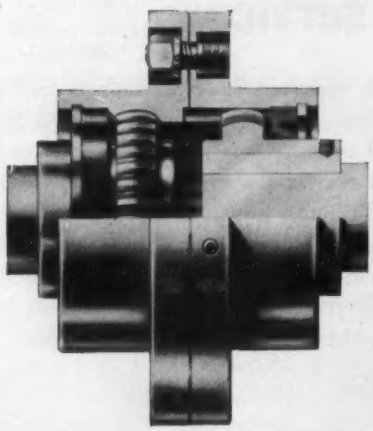

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FUEL ADDITIVES

Continued from page 198

ent or other sources of contamination like corrosive action. A quantitative analysis of chemical constituents and a study of the physical state of a deposit under investigation yields useful information about the origin and possible corrective measures.

A goal of an efficient additive is improving combustion and reducing deposit formation, whether the deposits occur in boiler heating surfaces and superheater regions, diesel-engine pistons, valves and ports, or gas-turbine rotor blades and nozzles.

If deposits are combustible, there is a soot problem that conventional methods might help considerably. In boilers, the burners require proper mechanical adjustment to insure correct air-fuel ratio. The oil should be heated to proper preheat temperature based on its viscosity. In diesels, it is often useful to investigate thoroughly such physical conditions as compression pressure and temperature, timing of fuel injection, and proper atomization.

In converting diesels from light to residual grades of fuel, it is important to make mechanical and operating changes recommended by the engine manufacturer. It may be necessary to modify the injector-tip design or change the combination of holes and angles of spray to provide efficient combustion. Sometimes advancing the period of injection is necessary. Higher injection pressure is often needed for heavy oils. One manufacturer found it desirable to overcome a rapid corrosion of exhaust valves by coating exhaust-valve seat faces with a nickel-chromium alloy.

Many times, additives improve combustion by the cumulative effect of their dispersing and detergent properties, emulsifying or demulsifying action, inhibition of oxidation and polymerization reactions, corrosion protection, and other properties. All these factors help provide the burner or diesel with a fuel having uniform characteristics. The reduction of varnish buildup and of lacquer and carbonaceous deposits, at the burner or injection tips and nozzles, leads to better fuel atomization with subsequent improved combustion efficiency.

Some additives incorporate combustion improvers to reduce soot and smoke. These materials, principally metallo-organic compounds, lower the ignition temperature of soot and make it burn more readily. Although such a chemical can lower the ignition temperature of soot when used in proper concentration, it is questionable whether enough of this can be present in an

(*Continued on page* 202)

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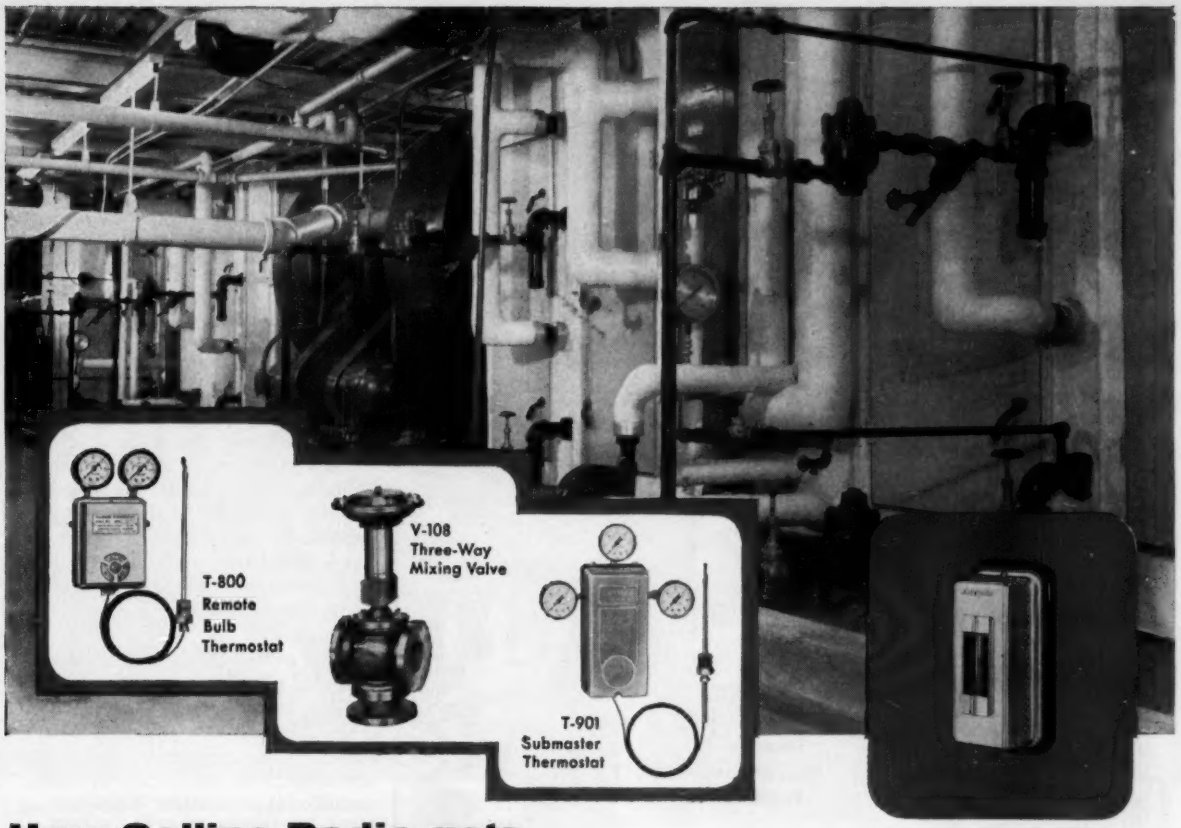

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A key feature of this modern controlled environment is a specially designed system of Johnson Air Conditioning Control. Johnson Thermostats, Valves, Dampers and other apparatus regulate the operation of eight central fan air conditioning units and related equipment to meet the special needs of each section of the building. Whether it's one of the large general office areas, a conference room, test area, laboratory, library or the cafeteria-auditorium, ideal temperatures prevail at all times.

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Johnson Pneumatic Control combines the adaptability, accuracy, and economy to solve *any* problem of heating, cooling, ventilating, air conditioning or process control. Johnson engineers know and understand thoroughly the special control problems of industry.

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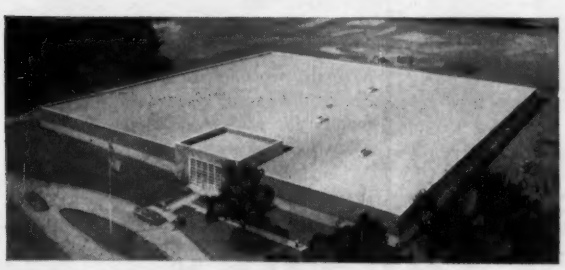

*Engineering and Research Building, Collins Radio Company, Cedar Rapids, Iowa. Abell-Howe Company, architects & builders, Chicago; Samuel R. Lewis & Associates, mechanical engineers, Chicago; J. W. Darragh, Inc., mechanical contractor, Cedar Rapids.

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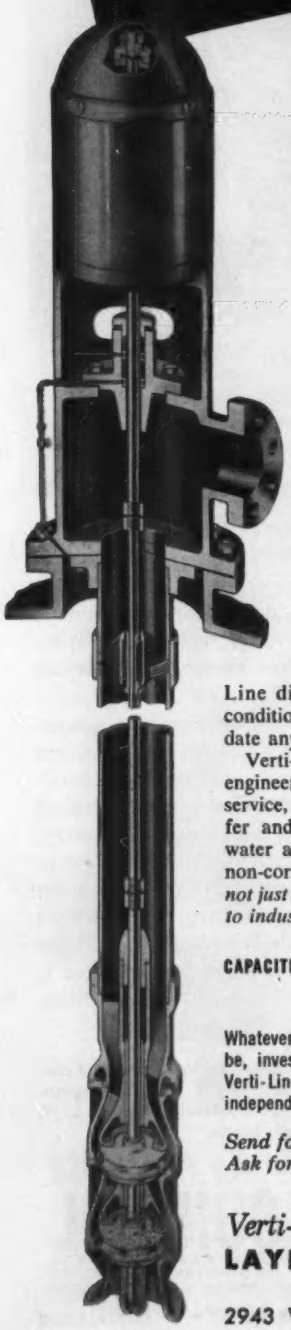
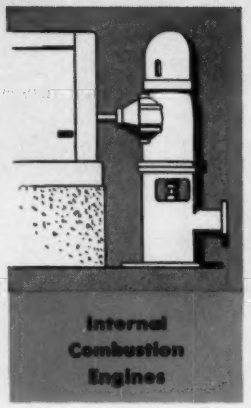
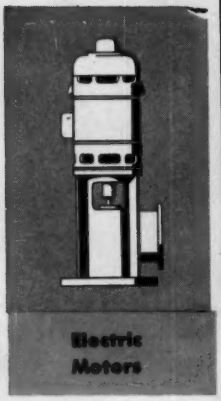
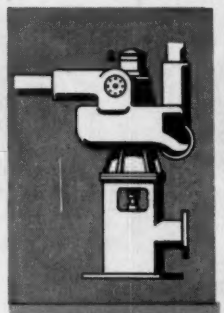




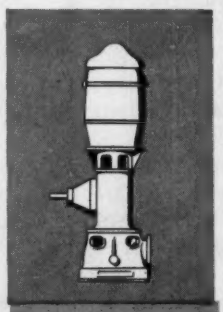
Internal Combustion Engines



Electric Motors



Steam Turbines



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FUEL ADDITIVES

Continued from page 200

additive to accomplish its purpose.

Dicyclopentadienyliron has shown ability to reduce soot and smoke and improve combustion. This chemical shows promise in improving residual oils as well as light oils. Another solution to combustion improvement might be offered by additives whose decomposition products are more powerful solvents for varnish, lacquer and carbonaceous residues than the original additive.

Safety. A consideration occasionally overlooked, yet highly important, is the capability of the additive in performing its function without hazards in handling and use. Its flash point should be not less than 170 F. Low-flash-point ingredients may liberate explosive fumes in a heated tank and endanger plant operations. The additive should be as safe to handle and store as the fuel itself.

Combustible chlorinated solvents, somewhat similar to carbon tetrachloride, are now frequently used in additives. These solvents present a toxicity hazard. Their permissible vapor concentration is as low as that of carbon tetrachloride; excessive concentration will endanger employe health. Chlorinated solvents also produce corrosive hydrochloric acid upon combustion.

Tests. Although there are yet no standards for evaluating fuel-oil additives, some simple tests can check the comparative effectiveness of additives. These tests do not take into account all possible variations or duplicate actual operating conditions; but they do help the operating engineer choose from the host of good, bad and indifferent treatments on the market today.

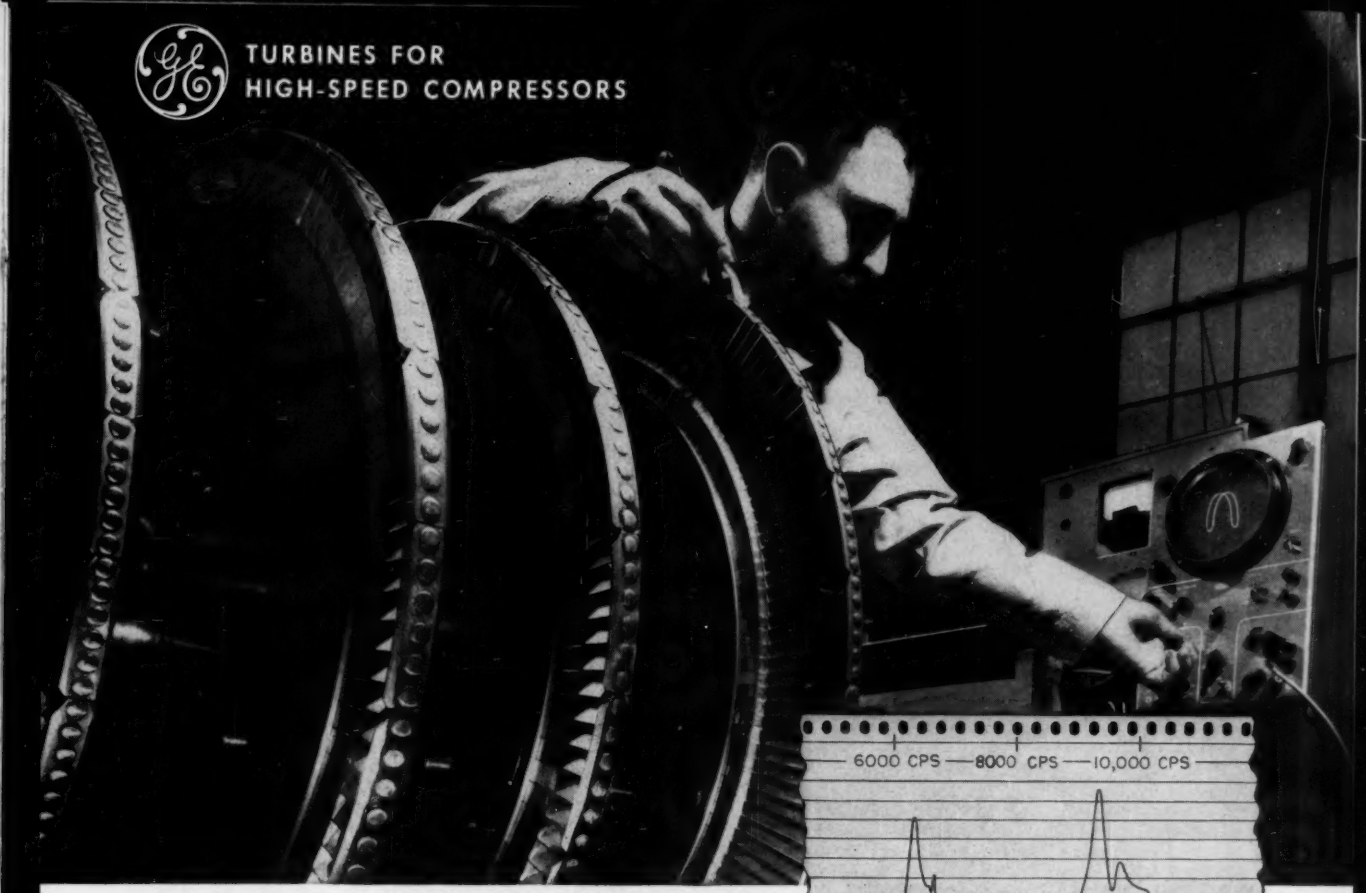
Sludge removal. Place on a dish or watch glass a drop of representative sludge from the storage tank, or heavy fuel if no sludge is available. Put a few drops of treatment on about four points of the watch glass, about halfway between the edge and the sludge. A treatment with good sludge-dissolving ability penetrates the sludge immediately upon contact. A good additive quickly causes sludge solution.

Sludge dispersal. To a light oil, like diesel No. 2, add ½% by weight of carbon black; use this sample as the control. Then make similar samples with various treatments at the normally recommended concentration. Shake the samples thoroughly and uniformly for a definite interval and set aside for observation.

The treatment is considered effective if particles remain in suspension for about 48 hours, compared to only a

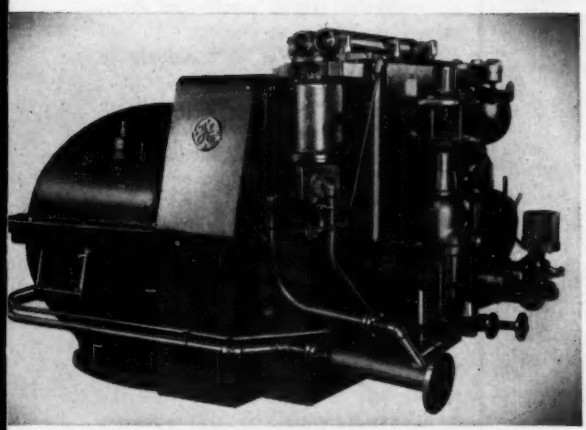
(*Continued on page 204*)

TURBINES FOR
HIGH-SPEED COMPRESSORS



VIBRATION RECORD, inset, is obtained by exciting buckets. Peaks indicate resonant vibration response of buckets. For more reliable operation, G-E engineers confine bucket exciting frequencies to "quiet zones" between the peaks.

How G-E Engineers Locate "Quiet Zones" for Safer High-speed Turbine Operation



TYPE DRV HIGH-SPEED MECHANICAL-DRIVE TURBINE

When driving modern compressors and blowers, G-E high-speed turbines spin at operating speeds of 7000 rpm and up. At such speeds, if resonant vibration were not controlled carefully, bucket fatigue failure might result.

HERE'S HOW General Electric combats the problem: Natural vibration frequencies of the buckets on each new turbine rotor are determined with the special equipment shown above—an oscillator, crystal pick-up, and high-speed level recorder. "Quiet zones" of minimum normal vibration are clearly revealed.

With this information available, the number of nozzles can be varied so that steam striking the buckets will create vibration-exciting frequencies only in these "quiet zones." By thus making sure that steam-impact frequencies don't coincide with critical natural frequencies, the chance of bucket failure is greatly reduced.

VIBRATION TESTING is one of many features that add to the reliability of G-E high-speed turbines. For more information, contact your nearest G-E Apparatus Sales Office or write for Bulletin GEA-6232, General Electric Company, Section 241-2, Schenectady 5, N. Y.

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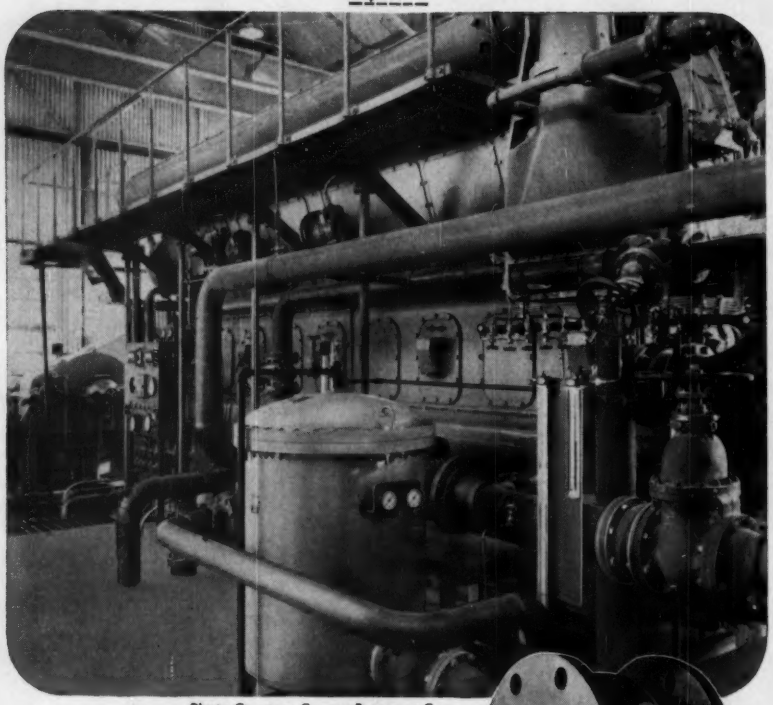
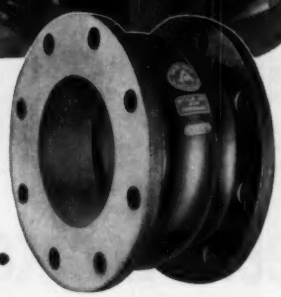


Photo Courtesy Cooper Bessemer Corp.

First Unattended Compressor Station Installs...



DEPENDABLE GARLOCK EXPANSION JOINTS Gulf Interstate Gas Company's Stanton, Kentucky station automatically pumps 400,000,000 cu. ft. of gas per day into northern markets. It's the first fully-automatic engine driven centrifugal compressor station...it's remote-controlled from Clementsville, Ky., 80 miles away. Obviously, the equipment supplied for such a project had to be the most reliable. Garlock neoprene-lined Expansion Joints were used on both oil and water lines to dampen vibration.

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FUEL ADDITIVES

Continued from page 202

few hours for the untreated sample. Treatment that retains carbon-black particles in a dispersed state for the longest time at minimum concentration is best in this function. Since characteristics of the oil determine the time of particle suspension, it is important to always run a blank untreated sample and the same light oil.

Inhibition. Store light samples of untreated and treated catalytically-cracked distillate oil in a constant-temperature oven at 210 F for 24 to 48 hours, or until the untreated control sample shows discolorization and the development of sediment as a precipitate, haze or film. An effective additive maintains oil in a clear condition when used at normal concentration. The best additive shows the least change in original characteristics at minimum concentration.

This test may be modified by aging the oil at 110 F for longer intervals, say six weeks; quantitative results are possible by collecting and weighing the sediment after filtration. Tests of much longer storage time at normal temperature can also be used. Always select the same oil when comparing the action of one additive against another.

Corrosion prevention. Place a brightly polished piece of steel—a nail, for instance—in each untreated and treated oil sample. To accelerate the test, store samples in a constant-temperature oven at an elevated temperature. The most effective additive is one that keeps the nail bright at minimum concentration. In an accelerated short-term test, it may be necessary to add 10 to 20% water to each sample to promote rusting of the nails.

A quick check for acid-neutralizing ability of additives consists of checking with phenolphthalein indicator. Shake the additive with an equal volume of distilled water and add indicator. A pink cast means the additive has acid-neutralizing ability. A pH meter can be used to determine the additive with greatest acid-neutralizing ability.

Effect on water. For a quick evaluation of an additive's action on water, simply mix an equal volume with the additive. If water quickly separates after mixing, the additive has little or no emulsifying properties. A good emulsifier maintains a homogeneous state, even for days. In this type test, the oil phase of the additive acts as the oil phase of the emulsion.

When testing emulsions produced with oil, use a light-colored one like lubricating or diesel oil so darkness

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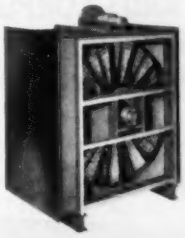

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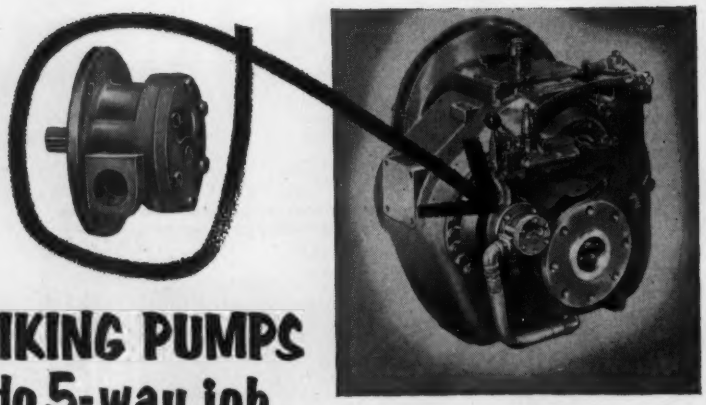

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FUEL ADDITIVES

Continued from page 204

of the oil does not mask activity. Additives can be compared by adding a few drops to mixtures of oil and water. Observe the completeness and permanence of the emulsion for comparative results.

Improved combustion. Although evaluating the properties of an additive to improve combustion should come from tests closely duplicating actual operating conditions, some simple tests give an indication of this property. An exploratory type of test consists of burning light grades of oil in kerosene lamps and noting the change in the sooty appearance of the chimney after a specified burning interval. The untreated and treated samples can then be compared.

Petroleum refiners evaluate the burning qualities of light oils with pot-burner tests, where a specified amount of oil is burned under controlled conditions. The resulting deposits are collected and weighed. This test can be used to compare different additives.

A far more extensive investigation showed that use of heavy oils for diesel engines is impractical without additives. A trial under carefully controlled and recorded conditions is probably the best way to determine the effectiveness of an additive in improving combustion.

Miscellaneous tests. An additive should be entirely compatible with the fuel. To check this characteristic, add several times the normal treatment dose to a light oil. No precipitation or insoluble residue should be expected from an additive that is completely compatible with the fuel.

Unless the additive is a special type, it should leave little or no residue after burning. Excessive ash, leading to after-combustion deposits, could cause abrasive wear in diesel-engine cylinders. To determine the ash content of the additive, burn a small sample and weigh the residue remaining after exposure to high temperature.

For the presence of a chlorinated solvent—which migh create a toxicity problem or cause release of hydrochloric acid after combustion—check as follows: Heat a clean copper wire in a Bunsen-burner flame until the green color of the flame disappears. Then let the wire cool, dip it into the treatment under test, and insert it again in the flame. If the green color reappears, a chlorinated solvent is present. To prevent interference from other components of the treatment, it is best to distill off approximately half the

(*Continued on page* 208)

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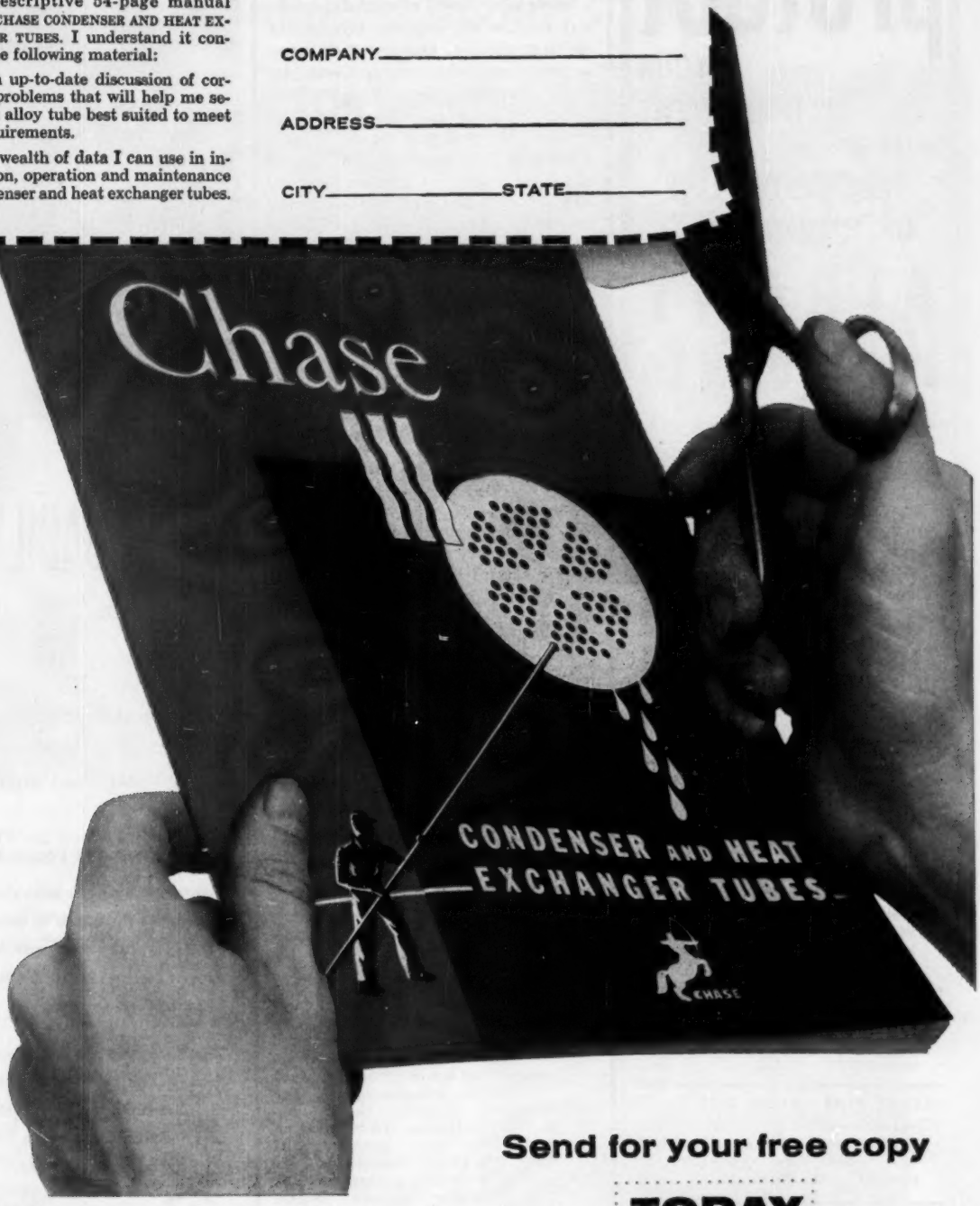

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FUEL ADDITIVES

Continued from page 206

solvent ingredients and conduct the test on the distilled portion.

Some other tests, of doubtful value, may confuse the engineer in selecting the right additive. One test of this type is concerned with water miscibility. Water miscibility is a property imparted to some additives by the inclusion of a coupling agent, usually a low-flash-point ingredient. When the additive and water are shaken together, some of the water goes into a solution free of cloudiness if such a coupling agent is present. However, only a limited amount of water can be taken up by the additive alone. More important, in an actual storage tank, oil would, of course, be present also. In the presence of both oil and water, this property is nonexistent. So the best test should be on an emulsification basis, which more nearly approximates actual conditions.

In another test, paper dipped into the additive is burned and checked for smoke or soot. Alcoholic-base treatments burn without soot or smoke in such a test, but even though an additive does smoke or create soot in this test, it may be a perfectly good treatment. Even the best grade of fuel oil burned under this condition shows soot and smoke.

More FREE LITERATURE

Begins on page 159

7 **Aerial cable** for electric utility and industrial power distribution systems is described in 13-p booklet 19-266. Includes discussion on application of aerial cable and when to use aluminum conductors, comparative costs of aerial versus open-wire installations and other related tables. Construction Materials Div, General Electric Co, Bridgeport 2, Conn.

8 **Storage batteries** of nickel cadmium are subject of two bulletins which give tabular data for various applications. No. 334 covers control and standby batteries for switchgear, standby power and emergency lighting. No. 168 describes batteries for starting heavy-duty gas, gasoline and diesel engines, operating fire pumps, standby generators and remote power sources. Nickel Cadmium Battery Corp, 70 Pleasant St, Easthampton, Mass.

9 **American Standards.** Sixteen hundred standards are indexed in new List of American Standards, including 400 in the electrical field. Fifty-six page booklet gives information on how to purchase American Standards (with quantity discounts) and those from other countries. American Standards

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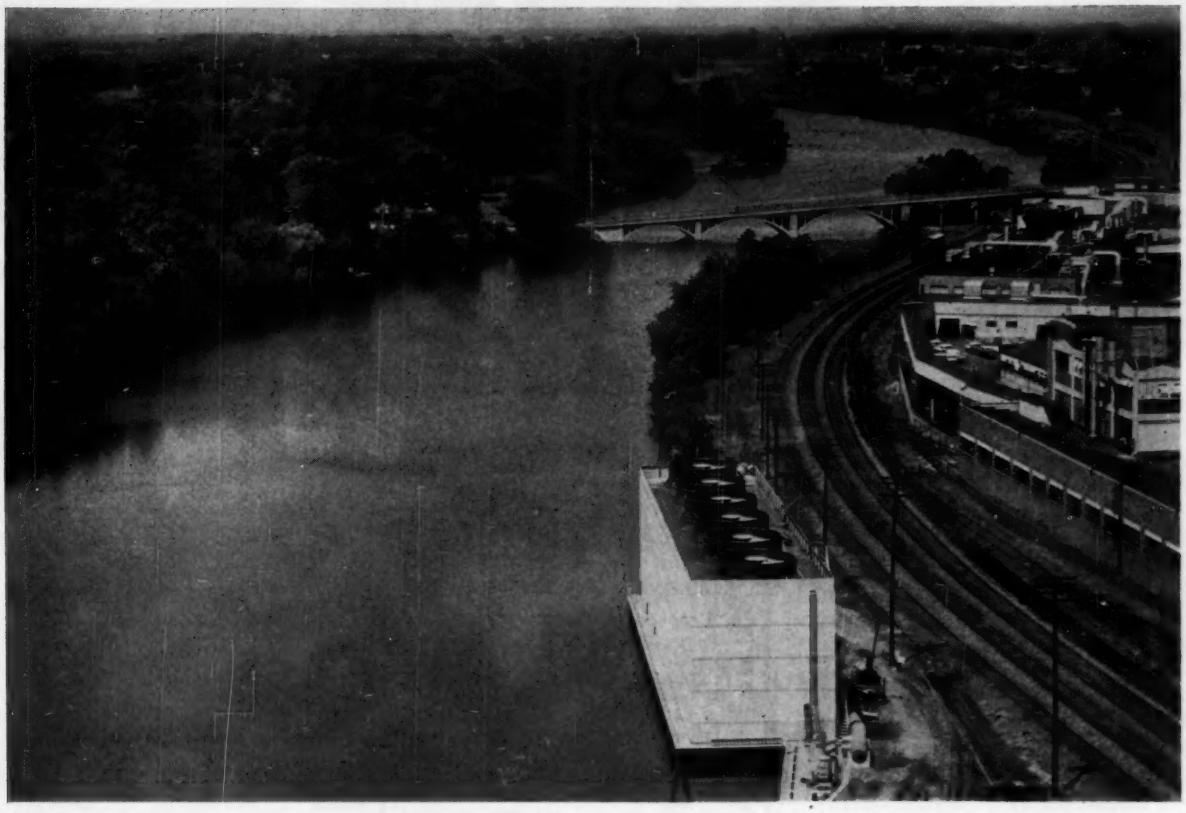
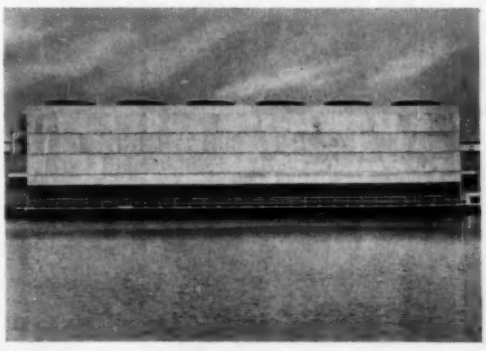


THE Board of Water and Electric Light Commissioners, Lansing, Michigan required 32,000 GPM additional circulating water capacity in order to add a new steam electric generating unit at the Moores Park Station. River flow during the summer months was insufficient, however, to meet the requirements of this rapidly growing load. A cooling tower installation proved the economic solution, in preference to relocating the new generating facilities. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

Pleasing architectural appearance of the tower was also an important consideration because of a municipal park across the river.

A Foster Wheeler six cell induced draft tower with cement asbestos board casing and stainless steel trim was chosen for this unusual installation.



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Association, 70 E 45th Street, New York 17, N. Y.

10 **Fractional-hp dc motors** with equipment are described in 12-p illustrated bulletin GEA - 6068. Covers complete line of fhp dc motors and equipment for direct application and built-in use. General Electric Co, Schenectady 5, N. Y.

11 **Battery charger.** Bulletin 13-200 describes divertor - pole, motor generator battery charger for the servicing of control-bus batteries in main stations and sub-stations. Illustrated 4-p booklet covers recent improvements in mechanical design of charger. Electric Products Co, 1725 Clarkstone Road, Cleveland 12, Ohio.

12 **Electric motors** are the subject of bulletin 1700. Two-color brochure includes photos and information on open drip-proof, as well as enclosed and explosion-proof, machines. Twenty large-sized photographs, including cut - away views, and 10 explanatory technical drawings and graph provide data on performance and application features. The Louis Allis Co, Milwaukee 7, Wis.

HEAT EXCHANGERS, CONDENSERS

13 **Condenser design,** maintenance, repair and heat exchangers are subjects of 6-p technical bulletin TB-412. Emphasizes quality, dependability and economy of electric - resistance welded carbon steel tubing in applications involving heat transfer. Chart outlines the hydrostatic test pressures required for various sizes of tubes under ASTM A-214 Tubular Products Div, Babcock & Wilcox Co, Beaver Falls, Pa.

14 **Heat exchanger,** sectional type, is described in illustrated 4-p bulletin 132. Explains functions of equipment to provide cooling liquids in industrial plants independent of a large supply of cooling water. Niagara Blower Co, 405 Lexington Ave, New York 17, N. Y.

MAINTENANCE EQUIPMENT

15 **Tube expander** and tube cutter described in 32-p illustrated catalog 81. Contains specs, information on operating accessories, tables of sizes, ordering information, list of national and foreign distributor locations. The Gustav Wiedeke Co, 1833 Richard St, Dayton 1, Ohio.

16 **Maintenance paints** are discussed in 20-p illustrated booklet with reference to municipal maintenance, paper mills, storage tanks. Hercules Powder Co, Wilmington 99, Delaware.

★ **Maintenance towers** are described in 4-p illustrated bulletin. Gives complete specs on all three models

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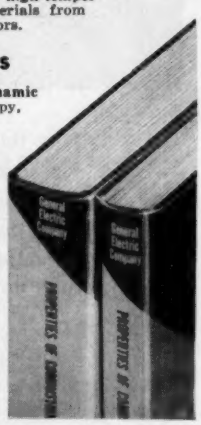

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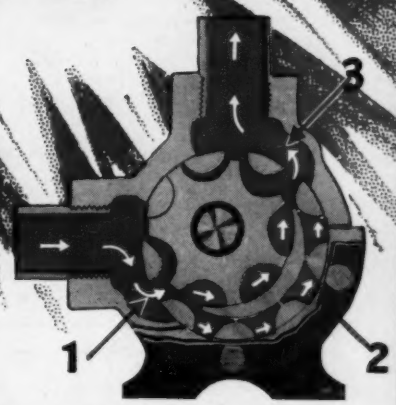

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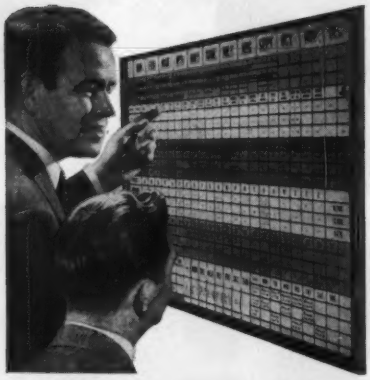

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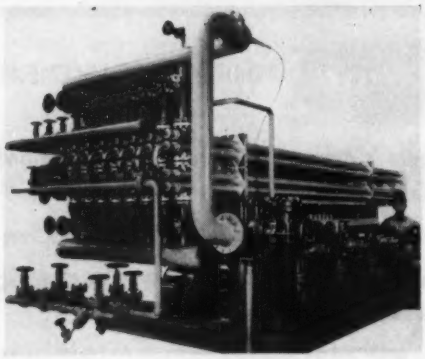

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of electro-hydraulic lift. ★Write direct on company letterhead to Safway Steel Products, Inc, 6234 W State St, Milwaukee 13, Wis.

17 **Dust collector** operation and construction explained in 12-p illustrated bulletin 100. Contains cutaway views, drawings, collection efficiency, capacity nomigraphs, design data tables for six available sizes ranging from 3 to 20 tubes. Research - Cottrell, Inc, Bound Brook, N. J.

18 **Sludge removal mechanism,** for cleaning rectangular sedimentation basins, is described as to design, types and sizes, and operation in 12-p two-color bulletin 6001-R. Includes sketches, line drawings, photos. Dorr-Oliver Inc, Barry Place, Stamford, Conn.

19 **Automatic lubricators,** featuring constant pressure rotary pump, are described in technical reference 55C. Three photographs show two types of constant pressure rotary lubricators and pump unit. Cross sectional drawing of pump body is included. Bijur lubricating Corp, 151 W Passaic St, Rochelle Park, N. J.

20 **Floating-roof seal** for storage tanks is described in illustrated catalog TS-56. Contains detailed answers to all questions on design, construction, materials, applications and operation. Hammond Iron Works, 630 5th Ave, New York 20, N. Y.

MATERIALS HANDLING

21 **Vibratory materials handling** equipment are described and pictured in 50-p catalog 564. Includes technical data and information on complete line of all models. Syntron Co, 492 Lexington Ave, Homer City, Pa.

22 **Belt idler** booklet 2-16, 12-p 2-color, contains design and application data for those who select, specify, purchase and use belt conveyors to handle bulk materials. Includes descriptions, dimensional drawings, spec tables and suggested applications for idlers and various troughing, impact, training and return brackets to use with belt widths of 18 through 72 in. Joy Mfg Co, 307 Oliver Bldg, Pittsburgh 22, Pa.

23 **Telescopic conveyors** are described in 24-p catalog 102. Illustrated with drawings, diagrams and installation photos. Wilkie Co, 5520 Arch St, Philadelphia 39, Pa.

MECHANICAL TRANSMISSION

★ **Torque converter,** *Series 13,800,* is the subject of bulletin 507. Illustrations and charts explain construction and application. ★Write direct on company letterhead to Twin Disc Clutch Co, Hydraulic Div, Rockford, Ill.

(*Continued on page* 214)

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25 **Fluid drive** for general industrial application is described in 2-p, illustrated bulletin 9719. Photographs show basic unit for use with engine drives and modified arrangement for electric motor driven applications. Includes installation type drawings giving basic dimensions and tolerances. Rating charts give the horsepower ranges for engine and electric motor drive speeds. American Blower Corp, Detroit 32, Mich.

26 **Series D-100 couplings** are discussed in catalog No. 62. Complete working data is given on sizes, capacities and dimensions. Ajax Flexible Coupling Co Inc, Westfield, N. Y.

METALS AND ALLOYS

27 **Nickel-aluminum bronze,** its development and application, is the subject of 8-p report. Contains tables, charts and photos. The International Nickel Co, Inc, 67 Wall St, New York 5, N. Y.

28 **Beryllium copper** is discussed in 4-p technical data sheet A-300. Gives engineering specs. Includes physical properties, temper information on high-strength strip and typical age hardening curves. American Silver Co. 36-07 Prince St, Flushing 54, N. Y.

29 **Alloy steels** are discussed in 4-p TDC-184 folder. Contains technical information on 12 of the most widely used *4100 series.* Includes data on carburizing and thermal treatments, critical points, mechanical properties and suggestions on welding and machining of these steels. Tubular Products Div, Babcock & Wilcox Co, Beaver Falls, Pa.

PIPING, VALVES, FITTINGS AND SPECIALTIES

30 **Seal pipe unions** and swing check valves are described in 20-p revised catalog 56. Contains pipe sizes, engineering data and specs. Includes information on lug nut unions and spring controlled check valves. Catawissa Valve and Fittings Co, 204 Main St, Catawissa, Pa.

31 **Installation accessories** for lubrication, hydraulic, steam, liquid and air applications, are described in 16-p catalog No. 17-E. Contains complete information and specs on adapters, nipples, clamps, etc. J N Fauver Co, Inc, 51 W Hancock, Detroit 1, Mich.

★ **Air control valves** for high- or low-pressure installations are the subject of 72-p illustrated catalog. Contains information on outstanding features, application data, dimensions, specs and parts list breakdown. ★Write direct on company letterhead to Airmatic Valve, Inc, 7317 Associate Ave, Cleveland 9, Ohio.

(*Continued on page* 216)

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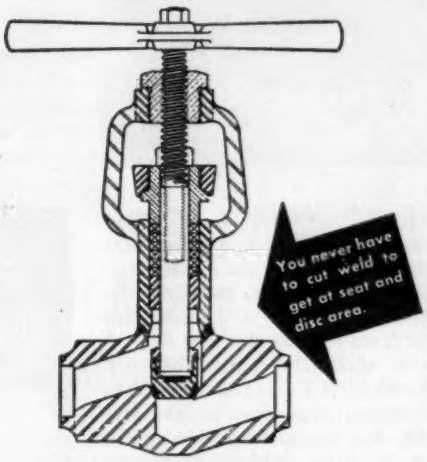

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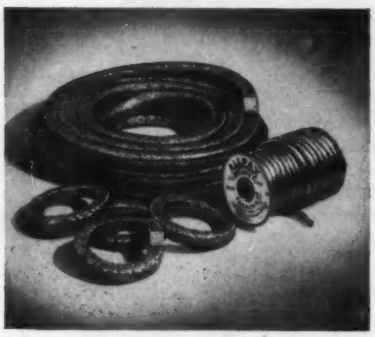

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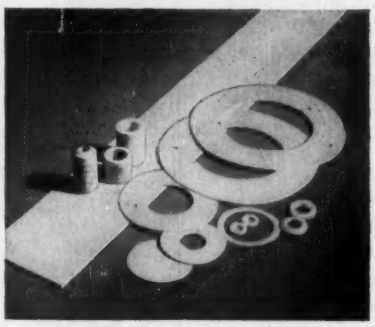

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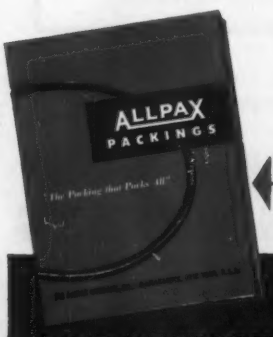

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32 **Pipe fittings** of forged steel are described in 28-p catalog A-3-56. Contains dimensional, engineering and application data on forged screw-end and socket-welding fittings for high-pressure service. Features a reorganization of data into simplified charts. W-S Fittings Div, H K Porter Co, Inc, P.O. Box 95, Roselle, N. J.

33 **Hose, fittings,** *Socketless* kits and self-sealing couplings are listed in condensed industrial catalog 174. Contains information on standard industrial products. Aeroquip Corp, Jackson, Mich.

34 **Gate valves,** bronze, 125 lb, are described in illustrated bulletin 566. Contains sizes, dimensions of *Fig.* 427 valves. Kennedy Valve Mfg Co, E Water St, Elmira, N. Y.

PUMPS

35 **Radial piston pumps** are described in 8-p illustrated bulletin 46000. Includes construction, operation, speeds, capacity and pressure ratings. The Oilgear Co, 1564C W Pierce St, Milwaukee 4, Wis.

36 **Centrifugal pumps,** cradle mounted, are described in bulletin 7223-B. Contains tabulation of pump types with rating, cross section view and performance tables. Ingersoll-Rand Co, 11 Broadway, New York 4, N. Y.

37 **Centrifugal process pumps,** for industrial, refinery and general service, are described in bulletin 184. Illustrated, 11-p circular contains photos, cutaways. Dean Brothers Pumps Inc, 323 W 10th St, Indianapolis 7, Ind.

38 **Canned motor pump** is described in illustrated, 4-p bulletin 1060. Contains details on performance, NPSH requirements, materials of construction, power inputs, temperature and pressure limitations. Chempump Corp, Station N, 1300 E Mermaid Lane, Philadelphia, Pa.

39 **Proportioning pumps,** as used in water conditioning, are described in 12-p, 2-color booklet 600. Includes pump specs, table for chemicals most commonly used in water conditioning, what they are used for and the pump construction best suited to inject them. Hills-McCanna Co, 2369 W Nelson St, Chicago 18, Ill.

WATER TREATMENT

40 **Water softeners** are described in illustrated, 6-p bulletin 105. Includes sample specs, layout, dimensions and engineering data. L A Water Softener Co, 1007 Airway, Glendale, Calif.

41 **Tray-type deaerator** is described in 4-p bulletin 4652. Contains photos, operation and construction details. Cochrane Corp, 17th St below Allegheny, Philadelphia, Pa.

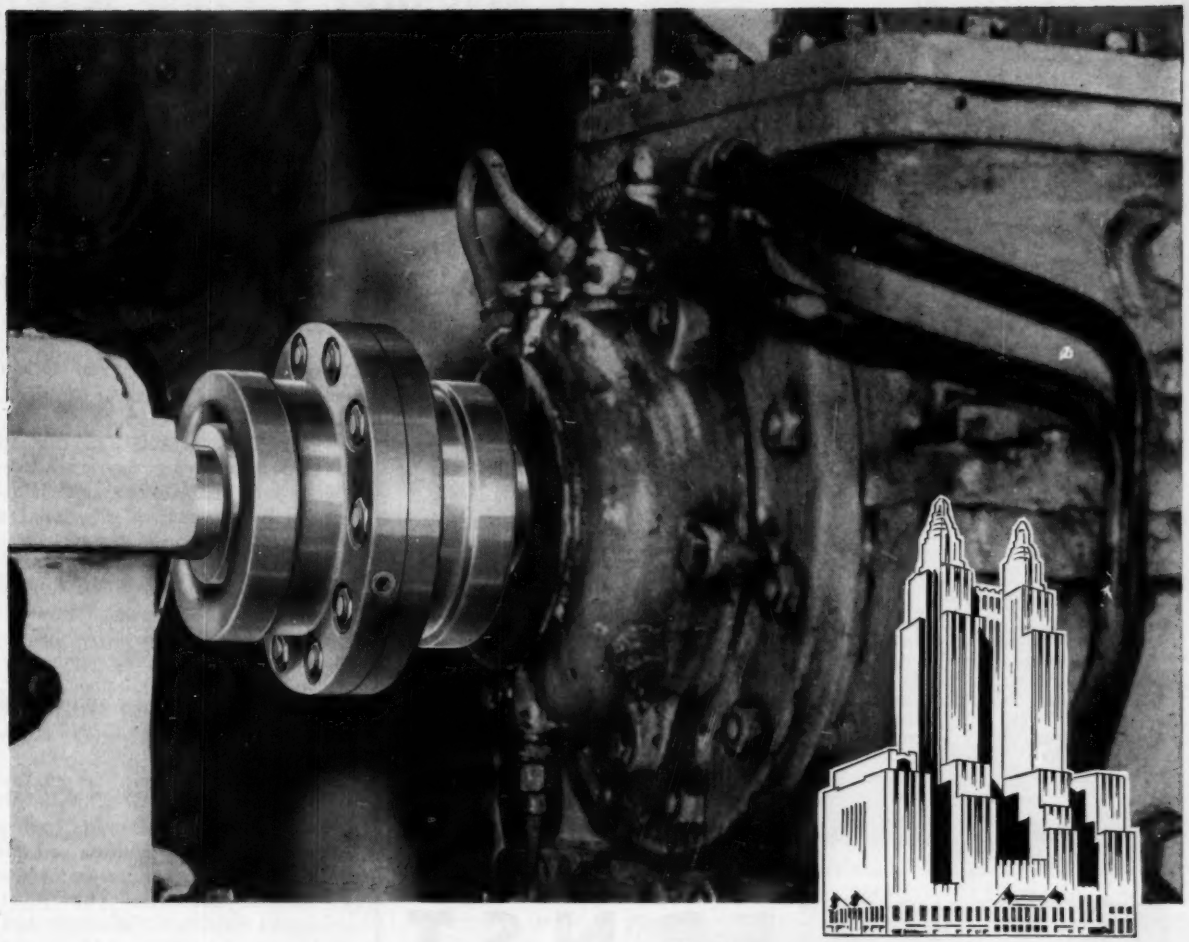

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FIG. 29 Cylinder with Impeller

FIG. 17-28 Cylinder

FIG. 215 Flanged

FIG. E-57 Double Window

FIG. 212 Visibility Welding Neck or Screw

FIG. E-811 Flapper

FIG. E-1810 Rotating Wheel Type

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More TECHNICAL BRIEFS

Begins on page 146

nature of a sliding surface. This paper reviews its contributions to the fields of lubrication, friction and wear. The theory of diffraction of electrons by crystals, specimen preparation and pattern interpretation is covered. Examples of electron diffraction patterns from standard materials and from some representative surfaces are presented. *ASLE paper; no number.*

Lubrication in the presence of nuclear radiation. *By R O Bolt and J G Carroll, California Research Corp.*

Some effects of pile radiation on lubrication of bearings and gears have been investigated. Three special lubricants having unusual radiation stability were used. Apparatus of two types was operated at 285 F in a nuclear pile. Each test was duplicated in the absence of radiation. Radiation damage markedly shortened the useful life of the lubricants. *ASLE paper; no number.*

The surface viscosity and elasticity of lubricating oils. *By Dean Criddle, California Research Corp.*

Some additives alter the surface viscosity and elasticity of a film of lubricating oil. These surface properties are readily measured at oil-air and oil-water interfaces with a torsion pendulum surface viscometer. This paper summarizes viscosity and elasticity data for these interfaces. New data are presented for sorbitan sesquioleate at several oil-water interfaces. The paper also discusses the significance of surface viscosity and elasticity in forming, emulsion stability and boundary lubrication. *ASLE paper; no number.*

Numerical solution of Reynolds' equation for sector thrust bearings. *By B Sternlicht, General Electric Co and J J Sneck, Rensselaer Polytechnic Institute.*

This paper presents a numerical method used for the solution of Reynolds' equation for sector thrust bearings. The method makes it possible to analytically arrive at the optimum film shape and bearing geometry giving the largest load-carrying capacity per prescribed minimum film thickness. *ASLE paper No. AM4A-2.*

Preliminary investigation of minimum oil-feed rate for fluid-film conditions in journal bearings. *By D D Fuller, Columbia University and Beno Sternlicht, General Electric Co.*

Many industrial bearings do not operate with an abundant supply of

Directions for ordering papers on p 224

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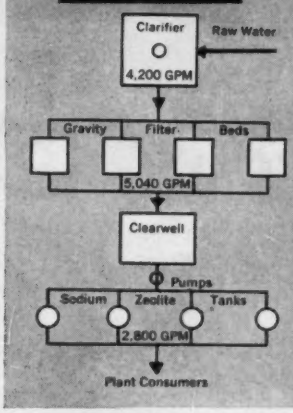

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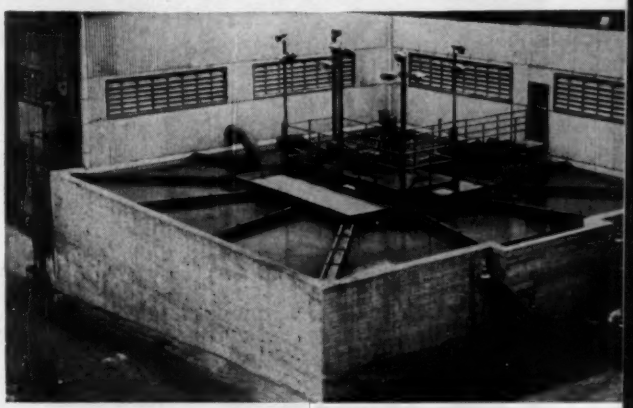
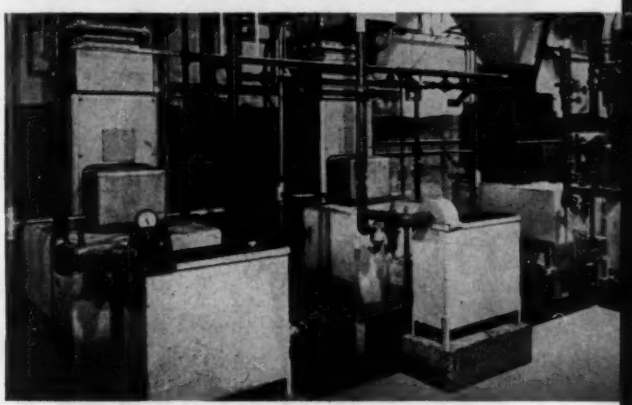


CLARIFICATION BASIN



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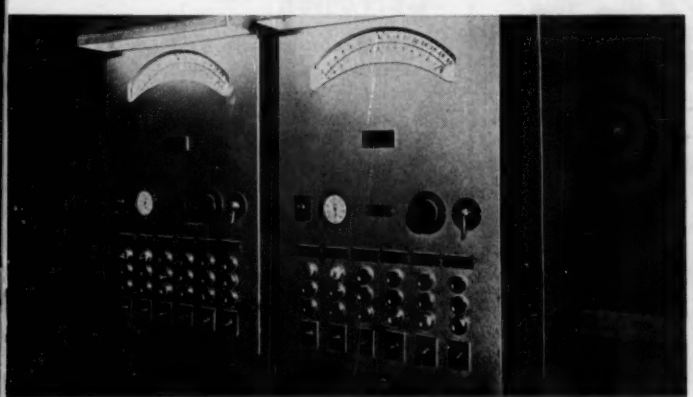
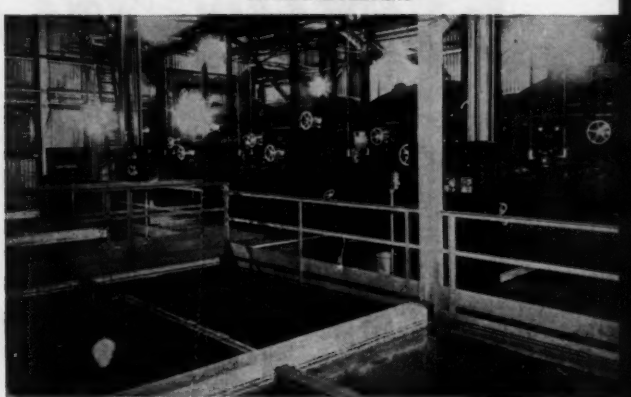


FILTER BED CONTROL PANELS



ELECTRICALLY CONTROLLED SODIUM-ZEOLITE SOFTENING UNITS

More TECHNICAL BRIEFS

Begins on page 146

lubricant. Bearings fed by wicks, pads and drop-feed oilers are in this category. A certain volume of lubricant must be supplied a journal bearing to permit formation of a complete hydrodynamic fluid film. This brings up the question of the minimum feed rate needed to insure operation with a fluid film.

The work described in this paper resulted in a method appearing promising for predicting the minimum feed rate for journal bearings. Minimum rate is evaluated in terms of speed, load, clearance and bearing size. *ASME paper No. 54-A-107.*

Dynamic demulsibility characteristics of oils. *By E W Brennan and R G Moyer, The Pure Oil Co.*

Methods currently used to determine demulsibility characteristics of circulating oils are quite empirical and afford little or no correlation with actual field performance. Dynamic demulsibility apparatus constitutes a realistic approach as it permits tests of the characteristics under essentially field conditions. Data presented by conventional methods and this apparatus are presented. These indicate the tests are of value to both research chemists and consumers. *ASLE paper; no number.*

Evaluation of anti-scuff properties of oils. *By D M Teague, E H Loeser, P J Willson and S B Twiss, Chrysler Corp. ASLE paper; no number.*

Evaluation of anti-wear properties of oils. *By S B Twiss, E H Loeser and D M Teague, Chrysler Corp. ASLE paper; no number.*

The mechanism of "free" rolling friction. *By D Tabor, University of Cambridge, Eng. ASLE paper; no number.*

A lubrication engineer surveys steel mill gearing. *By A E Cichelli, Bethlehem Steel Co. ASLE paper; no number.*

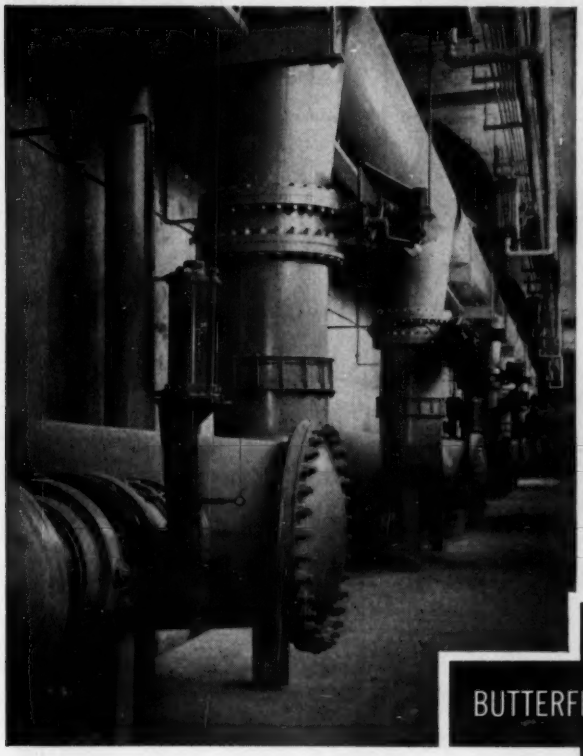
Corrosion

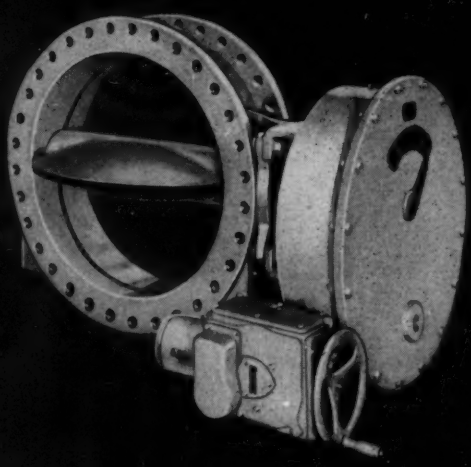
Fretting corrosion. *By H H Uhlig.*

Fretting corrosion occurs whenever a metal in contact with another metal or non-metal is subject to relative slip. Damage of this kind presently worries the mechanical engineer who designs or operates vibrating machinery and structures and the problem is one that the corrosion engineer should know more about. Examples of fretting damage to industrial equipment are reviewed, together with fundamental fac-

Directions for ordering papers on p 224

DROP-TIGHT SHUTOFF R-S Rubber-Seated Butterfly Valves give drop-tight closure to 125 psig through wedge-type action of the disc within a one-piece rubber seat. 65 of these valves, installed as shown for service in the San Jacinto River project near Houston, gave a substantial space reduction and direct, in-place cash savings of $124,000.





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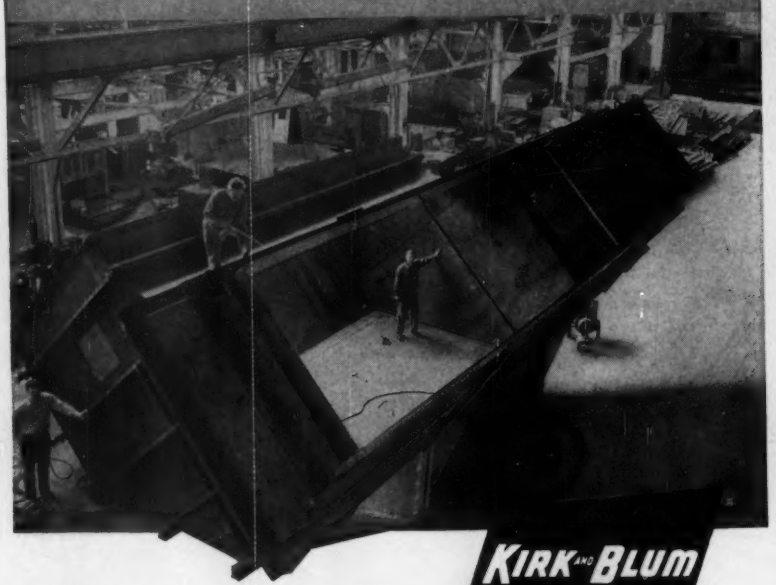

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More TECHNICAL BRIEFS

Begins on page 146

tors such as environment, load, magnitude of slip and frequency of vibration. The mechanism of damage is discussed and remedial measures are outlined based on practical experience and suggestions derived from the proposed mechanism. *NACE paper No. 1.*

Corrosion fatigue. *By Israel Cornet.*

Metals subjected to cyclic tensile stress in a corrosive environment may suffer an attack known as corrosion fatigue. The part subjected to alternating stress shows numerous deep sharp pits; from which cracks and subsequent failure originate.

Corrosion fatigue damage is more common than is generally appreciated. It results in failures of components under cyclic stress at a fraction of their conservative design strength and time, failures that are not anticipated by conventional design data on fatigue or corrosion alone. For example, in carbon and low alloy steels, improvement in mechanical properties obtained by cold working or heat treatment is of little or no benefit in resisting corrosion fatigue.

Corrosion fatigue can be eliminated by suitable selection of materials, but this may not be economic. In a susceptible material, corrosion fatigue may be controlled by reducing stresses. Cathodic protection can be effective and often use of an inhibitor has proved to be economical in halting fatigue. *NACE paper No. 20.*

Selection of rust inhibitors to meet service requirements. *By A J Freedman, A Dravnieks, W B Hirschmann and R S Cheney.*

Rust inhibitors should be selected with reference to types of service in which they will be used. Many inhibitors give satisfactory results under mild rusting conditions but fail under more severe conditions. Laboratory testing programs should be designed, therefore, to reproduce as closely as possible the conditions of actual practice.

Rust inhibitor test methods are discussed in relation to three general classes of service corresponding to flowing, static, and condensation conditions. A new rust inhibitor testing procedure, based on the Indiana Conductometric Method, provides quantitative measurements of very low corrosion rates under carefully controlled conditions. Small differences in performance of good rust inhibitors have been detected by this method.

Choice of a general rust inhibitor

Directions for ordering papers on p 224

Ingersoll-Rand High-Pressure Pumps at the Katy Cycling Plant

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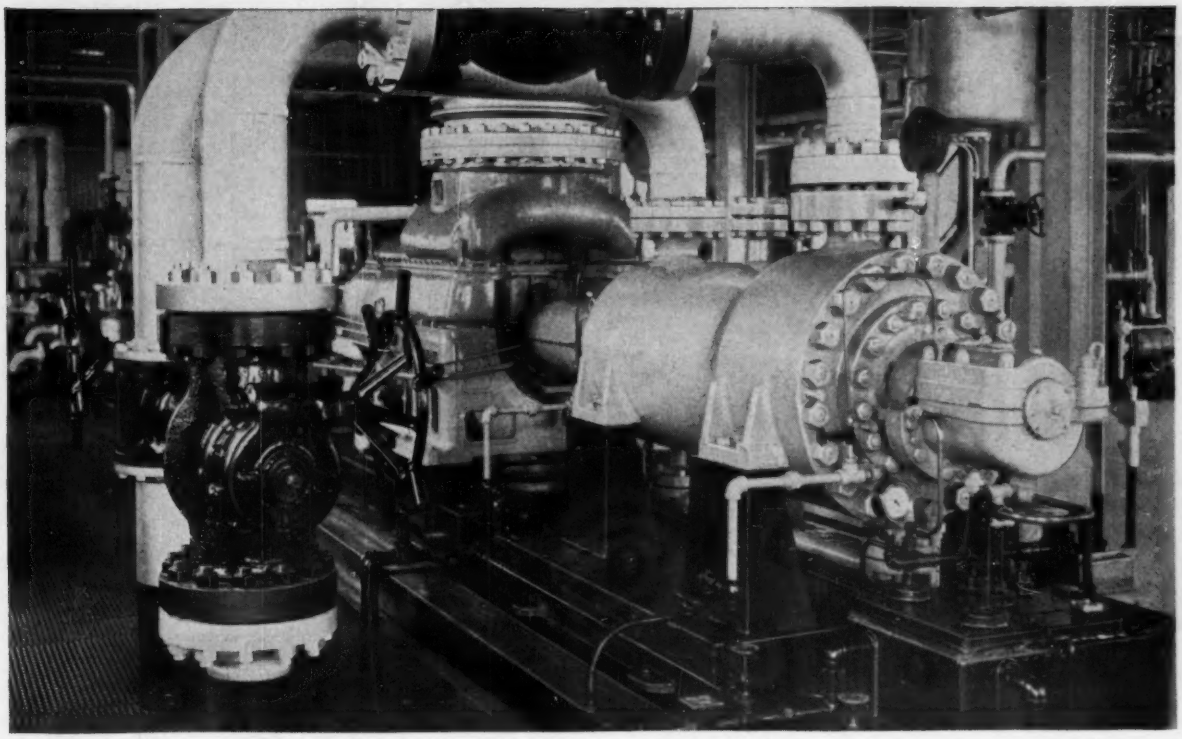
of Maintenance-Free Operation



Two nine-stage CHT pumps were put into service at the Katy Cycling Plant in July 1943. These five-inch, double-case units, one of which is shown above, take lean oil at about 90°F. and 70 psi from the still after coolers and discharge it to the absorbers at 1850 psi. Throughout this entire thirteen year period, the pump casings have not been opened. The original bearing linings are still in service and the only maintenance required has been the renewal of inboard shaft sleeves and infrequent repacking. A third I-R pump of the same design, installed in 1944, has required no repairs to date.

This outstanding performance record is a typical example of the *extra dependability* that's built into every Ingersoll-Rand pump. Each unit is designed for real, long range economy that pays off in lower operating and maintenance costs year after year. If you have a pumping problem, your nearest I-R representative will be glad to help you.

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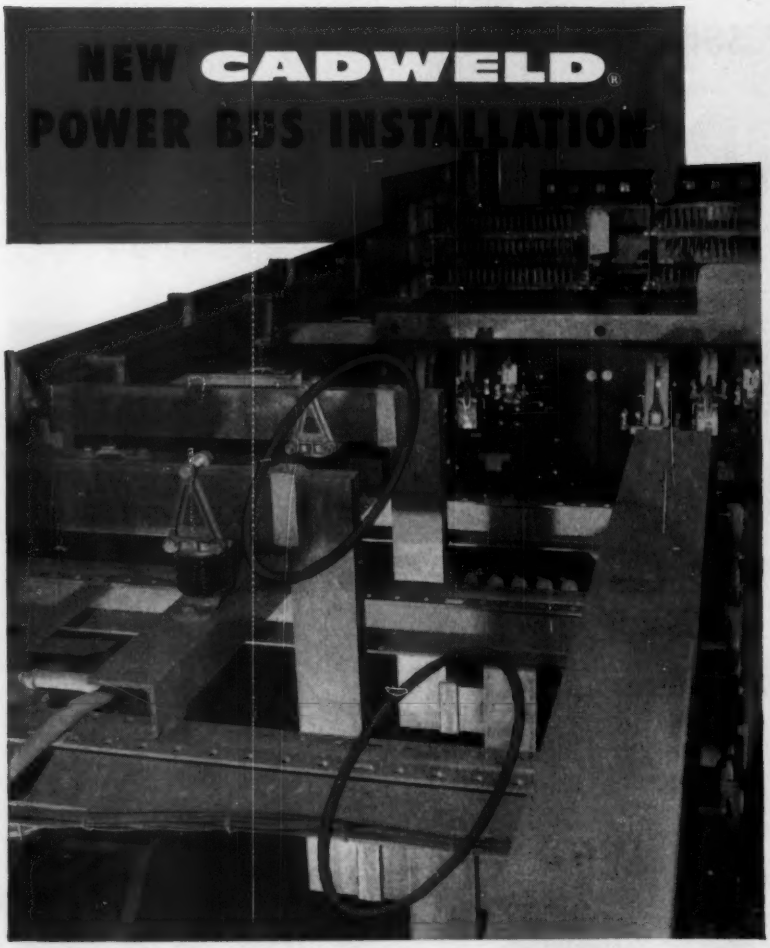

PATTERSON-EMERSON-COMSTOCK, INC., Pittsburgh Electrical Contractor recently completed an electrical power installation for the JONES AND LAUGHLIN STEEL CORPORATION at their Seamless-Tube Stretch Reducing Mill, Aliquippa, Pennsylvania.

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More TECHNICAL BRIEFS

Begins on page 146

(aqueous- or oil-soluble) as well as the particular compound to be used, should be based on results of selected quantitative laboratory tests. Correlation with field tests and experience, analysis of relative cost data for useful inhibitors, plus an economic evaluation of possible alternative procedures, should be considered for obtaining any desired degree of rust protection. *NACE paper No. 8.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

American Society of Mechanical Engineers. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, New York.

American Institute of Electrical Engineers. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, New York.

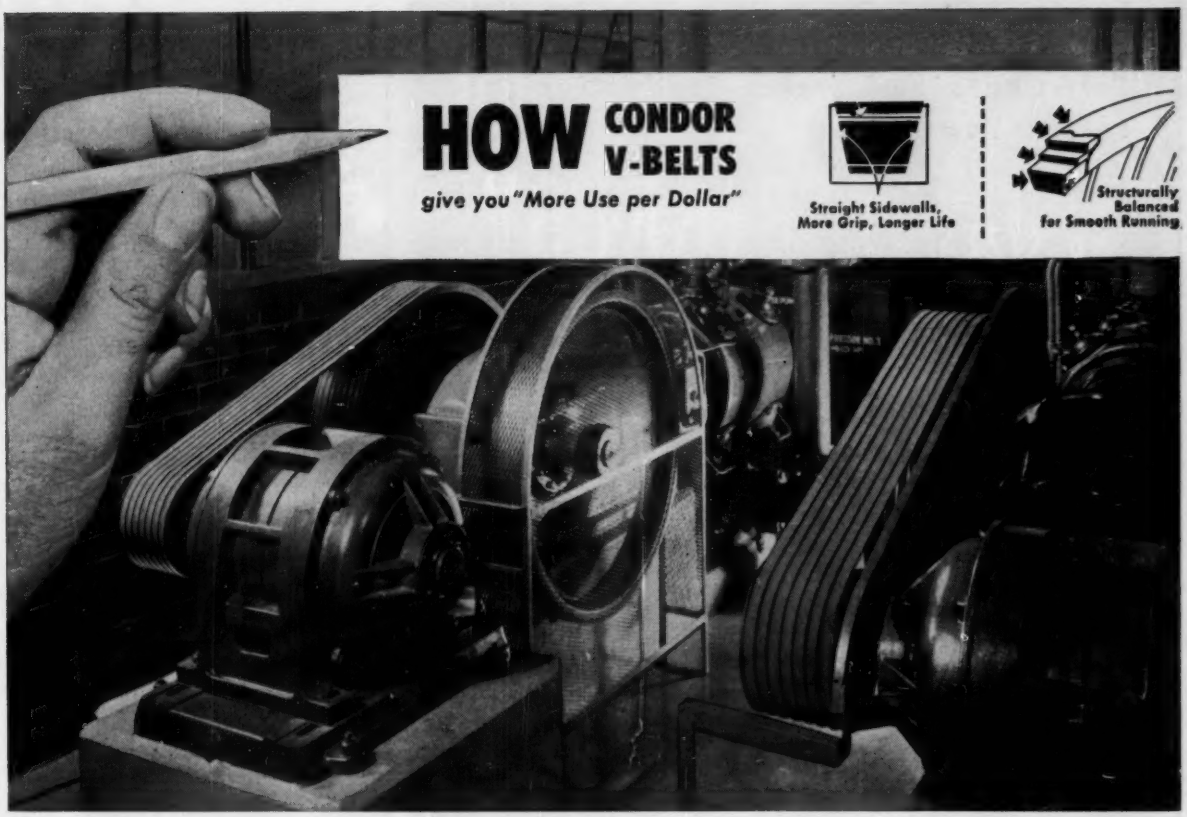
American Power Conference, 18th annual meeting. Identified by initials APC and obtainable through purchase from Director, APC, Illinois Institute of Technology, Chicago 16, Ill.

National Association of Corrosion Engineers, 12th Annual Conference. Identified by initials NACE. For further information contact NACE, 1061 M & M Building, Houston 2, Texas.

American Society of Lubrication Engineers, identified by initials ASLE. Information as to availability from ASLE, 84 E Randolph St, Chicago, Ill.

World Power Conference, 5th meeting, identified by initials WPC. Information as to availability obtainable from Oesterreichisches Nationalkomitee der Weltkraftkonferenz, Vienna I, Schwarzenbergplatz 1, Austria.

National Safety Council has published the 1956 National Directory of Safety Films. It provides a compact source of information on films on safety, first aid, fire prevention and civil defense. More than 1200 films, available without restriction on distribution, are described. Single copies of the directory may be purchased for $1 from the National Safety Council, 425 N Michigan Ave, Chicago 11, Ill.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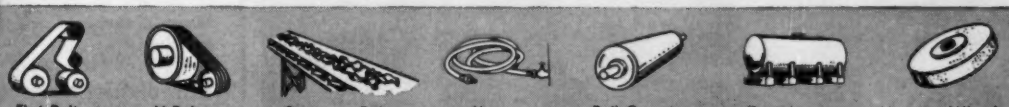

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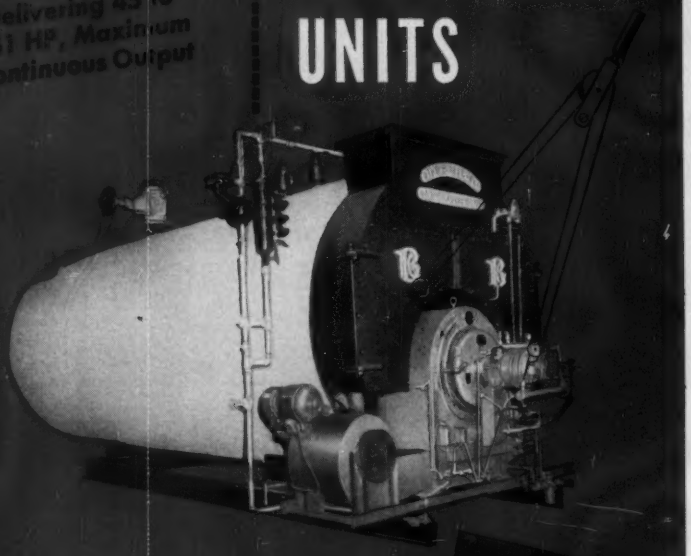

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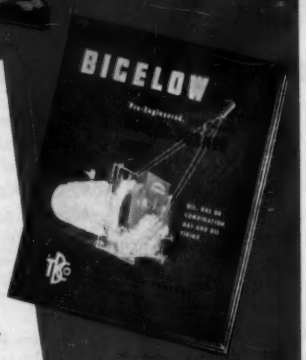

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BI-17

APPOINTMENTS

Corporation executive changes

Dodge Manufacturing Corp: Carl W Petersen, executive vice-president. **Rodney Hunt Machine Co:** Earl F Harris, president. **The Colson Corp:** Norman A Price, executive vice-president; Jack J Begley, vice-president, manufacturing. **Walworth Co:** Robert Graves, executive vice-president. **U.S. Rubber Co:** John W McGovern, executive vice-president. **LaSalle Steel Co:** Thomas A Kelley, executive vice-president.

Operations executive changes

S Morgan Smith Co: Carl J Wilcox, manager of valve operations **Schutte & Koerting Co:** LeRoy S Harris, manager of research and development dept. **Joy Manufacturing Co:** William Hanson Jr, manager of conveyor products. **General Electric Co:** Maynard W Johnson, general manager of large motor and generator dept. **Carrier Corp:** Philip P Anderson, director of development in absorption refrigeration. **Burns and Roe, Inc:** Seymour Baron, technical director of chemical and nuclear section.

Engineer changes

The Fluor Corp, Ltd: Otto H Hedrich, principal power engineer—mechanical; Charles B Bennett, principal power engineer—electrical. **The B F Goodrich Co:** Daniel L Pellett, director of engineering services; George S Ketter, manager of engineering design. **A O Smith Corp:** W W Higgins, chief engineer. **Copeland Refrigeration Corp:** E R Boynton, chief engineer. **Wheeler Associates, Inc:** Frank H Wark Sr, director of engineering. **Rockwell Manufacturing Co:** Russell L Sylvester, chief engineer of central valve research and development dept. **Allis-Chalmers Manufacturing Co:** Ralph T Green, application engineer, transformer dept; A C Ostrowski, application engineer, compressor dept.

New sales managers

Chase Brass & Copper Co: John J Vreeland, staff manager, sheet and strip; Allan R Armstrong, staff manager, tube sales; Herman H Kremer, staff manager, rod and wire. **Airdesign, Inc:** David H Kollock, general sales. **Nickles Machine Corp:** H A Morris, general sales. **McGill Manufacturing Co:** James C McGill, distributor sales.

New district managers

The Babcock & Wilcox Co, Tubular Products div: J N Rogers, St. Louis office, succeeding Frank T Murphy,

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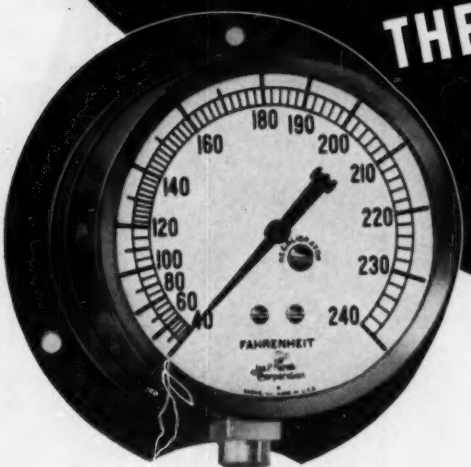
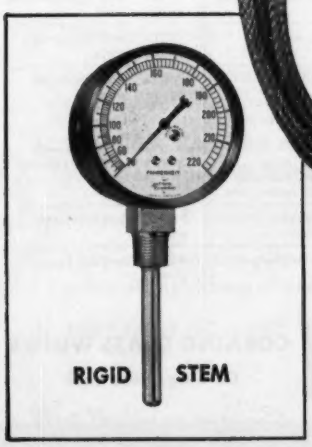


DISTANT READING



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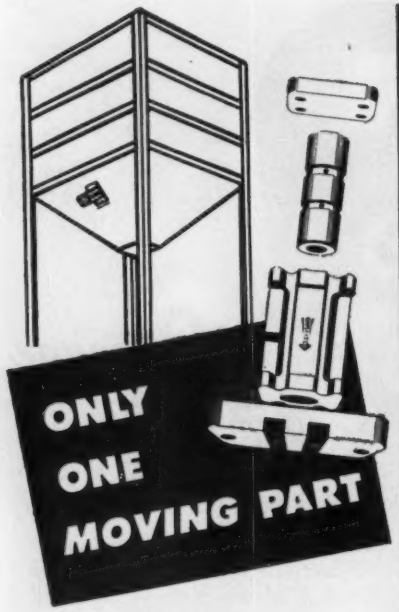

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More APPOINTMENTS

Begins on page 226

retired. **Coles Cranes, Inc:** Herbert P Strack Jr, East Coast region. **The Jeffrey Manufacturing Co:** William K Myers, New York office; Tom Fear Jr, St. Louis office; John Chrystal, Columbus office.

Schutte and Koerting Co: John H Peterson, New York City office. **L O F Glass Fibers Co:** R H Barnard Jr, Charlotte, N. C. district; E A Turner, Chicago district. **Cooper - Bessemer Corp:** R F Bartlett, Dallas branch. **Jas P Marsh Corp:** Harry Kirby, Cleveland district manager.

New district offices

Fischer & Porter Co: at 603 Rue Max St, Pensacola, Fla. **Tube Reducing Corp:** at 10336 S Western Ave, Chicago, Ill., D L Watson, manager. **Raybestos-Manhattan, Inc,** Manhattan Rubber div: creation of Eastern sales region with offices at 500 5th Ave, New York, N. Y., R F Teeling, manager. **The Bristol Co:** Western sales office in Denver, Colo., R G Tower, manager.

New distributors

For **Automatic Switch Co:** Delaware Valley Engineering Co, Inc, 3326 Lancaster Ave, Philadelphia 4, Pa.; Hendrie and Bolthoff Co, 1635 17th St, Denver 17, Colo.; and Hydraulic Equipment Co, 5924 E Olympic Blvd, Los Angeles 22, Calif. For **The New York Air Brake Co:** Nielson Hydraulic Equipment, Inc, 4 Penn Pl, Pelham Manor, N. Y. For **Stoody Co:** Hardfacing Sales & Engineering Co, 242 E 103rd St, Chicago 28, Ill.

New representatives

For **J F Prichard and Co of California:** Sears-Westall Co, St. Louis, Mo.; and R A Darling Co, Wheat Ridge, Colo. For **Barber - Colman Co,** Wheelco Instruments div: Instruments, Inc, 122 N Madison, Box 556, Tulsa, Okla. For **Schutte and Koerting Co:** Wayne Wiscomb Co, Box 19, Sugarhouse Station, Salt Lake City, Utah. For **R P Adams Co;** Harry C Ohge, 5324 Primrose Ave, Indianapolis, Ind.

For **Hammel-Dahl Co:** George Haynes Co, 406 W 34th St, Kansas City 11, Mo. For **The Peerless Electric Co,** Fan and Blower div: The Paller Engineering Co, 3025 N Illinois St, Indianapolis, Ind. For **American Agile Corp:** The Haynes Co, 1215 E 20th St, Tulsa, Okla. For **Hills-McCanna Co:** General Meters and Controls Co, 205 W Wacker Dr, Chicago 6, Ill., and Telco, Inc, 4030 Superior Ave, Cleveland 3, Ohio. For **Simplex Valve & Meter Co:** Ward K Stallings Co, 3120 Maple Dr, NE, Atlanta 5, Ga.

(*Continued on page 230*)

When 3 gauge glasses can cost less than only 1

The money you spend to have a spare and a *spare* spare may save big money in prevented down time.

It works like this:

Order 2 spares for every gauge glass in your plant. Use 1 for routine replacement. Keep 1 for emergency use. This extra spare you buy now costs nothing extra because you'll buy one eventually, anyhow. By stocking ahead, you protect yourself. Free insurance, really.

Remember: "ONE FOR THE GAUGE AND TWO FOR THE SHELF." And always specify hard-to-break CORNING®, PYREX® and MACBETH® gauge glasses. It's the economical way.

CORNING INDUSTRIAL GLASSWARE FOR EVERY JOB

Application	*Recommended Product*
Normal Conditions (Up to 100 p.s.i.)	CORNING brand standard gauge glasses
Higher temperatures	PYREX brand high-pressure gauge glasses
Higher pressures	PYREX brand heavy-wall gauge glasses
Extra visibility	PYREX brand red-line gauge glasses
Heavy-duty service	MACBETH brand flat gauge glasses
Viewing inside furnaces, reactors, pressure vessels, etc.	PYREX brand sight glasses
Lubrication inspection	PYREX brand lubricator glasses
Visible discharge devices	PYREX brand oil cup glasses

CORNING GLASS WORKS

Corning, New York

Corning means research in Glass

...you get

21% to 42% MORE ELBOW for the same cost

When You Use MIDWEST "LONG TANGENT" ELBOWS

90° LONG RADIUS LONG TANGENT
SIZES: 2" THRU 36"

90° SHORT RADIUS LONG TANGENT
SIZES: 14" THRU 36"

45° LONG RADIUS LONG TANGENT
SIZES: 2" THRU 30"

ADVANTAGES OF MIDWEST "LONG TANGENT" ELBOWS

- ★ They save pipe.
- ★ They often eliminate short nipples and their extra welds.
- ★ They save time and money in lining up and clamping pipe and fitting.
- ★ They make it easier to apply slip-on flanges.
- ★ They remove the circumferential weld from point of maximum stress and can be sleeved.
- ★ THEY COST NO MORE THAN OTHER ELBOWS.

The long tangents available *only* on Midwest Welding Elbows give you *more fitting for the same price* . . . Midwest "Long Tangent" Elbows cost no more than other elbows. This added length has numerous advantages for the user of welded piping . . . advantages that save money and improve piping. For all the facts, ask the nearest Midwest distributor or write us for Catalog 54.

MIDWEST PIPING COMPANY, INC.

Main Office: 1450 South Second Street, St. Louis 4, Mo.
Plants: St. Louis, Clifton, N.J. and Los Angeles

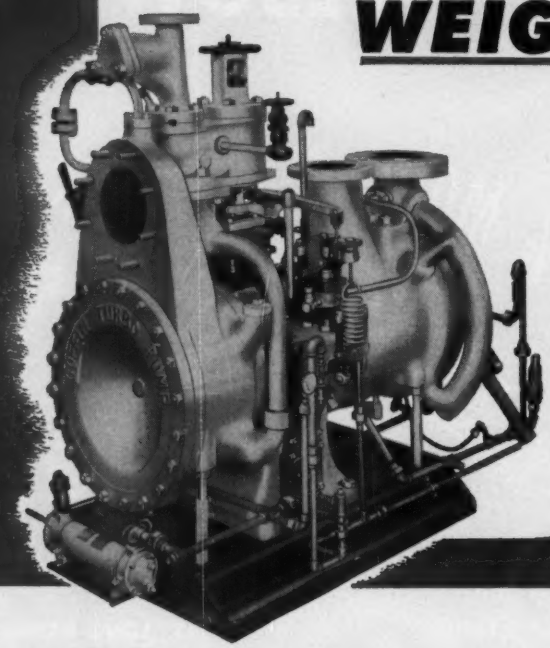
Sales Offices:
New York 7—50 Church St. • Chicago 3—79 West Monroe St. Cleveland 14—616 St. Clair Ave. • Los Angeles 33—520 Anderson St. Houston 2—1213 Capitol Ave. • Tulsa 3—224 Wright Bldg. • Miami 34—2103 Le Jeune Rd. • Boston 27—426 First St.

STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS

7324

SAVE
SPACE
STEAM
WEIGHT



Type DEB
2-stage unit

With Dependable COFFIN Turbo Feed Pumps

Matched pump, turbine and governor are compactly designed and precision built as an integral unit to assure years of dependable performance—in minimum size, with low steam consumption. Widely used for boiler feed service in refineries, chemical plants, paper mills and general industry, the well-known line of Coffin Turbo Pumps offer Volumetric Ranges to 800 gpm, Discharge Pressures to 1500 psig, Steam Temperatures to 950° F., Exhaust Pressures to 200 psig, and Liquid Temperatures to 325°F. For special installations these ratings may be exceeded.

● **ENGINEERS . . . write today for complete specifications on the entire line of Coffin Turbo Pumps.**

THE J. S. COFFIN JR., COMPANY
Englewood, New Jersey
TURBO PUMPS

More APPOINTMENTS

Begins on page 226

Recent purchases

Vapor Heating Corp: purchase of Roth Rubber Co. **A P Green Fire Brick Co:** acquisition of The Pyro Refractories Co, Durex Refractories Co, and Portsmouth Clay Refractories Co. **Fuller Co:** acquisition of Lehigh Fan & Blower Co. **I-T-E Circuit Breaker Co:** acquisition of all capital stock of Kelman Electric & Manufacturing Co.

Retirements

Herbert F Sauer, industrial sales manager, Midwestern region, The Electric Storage Battery Co, after 51 yrs of service.

Charles W Burrage, manager of engineering sales, Lunkenheimer Co, after 32 yrs of service.

Andrew K Bushman, manager of engineering, apparatus sales div, General Electric Co, after 44 yrs of service.

Fred Knight, Western sales manager, Mead-Morrison div, McKiernan-Terry Corp, after 43 yrs of service.

Obituaries

Philip Arnold, 73, retired vice-president of The Garlock Packing Co, on July 3rd.

Luke R Hadnot, president, Piping and Equipment Co, Inc, on July 4th.

Leeds & Northrup Co has become a member of Atomic Power Development Associates, Inc, and L&N President I Melville Stein has been elected a director of the group.

Union Carbide Development Co has been formed as a new division of Union Carbide and Carbon Corp, it was announced by Morse G Dial, Union Carbide's president.

"I hear that those guys who wear their holsters low are plenty fast on the draw."

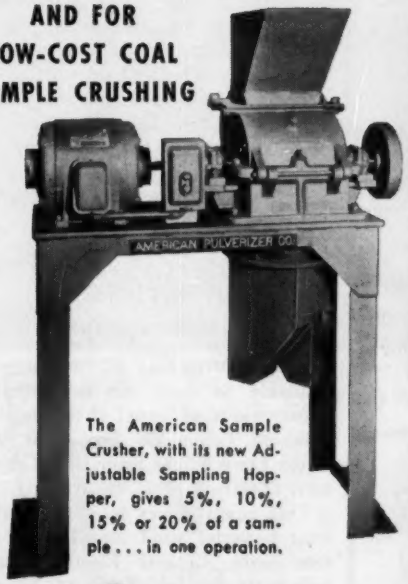
on their way
to better
coal preparation

"AC"
ROLLING RING
COAL
CRUSHERS

COAL IS SPLIT
-NOT CRUSHED

three big crushers with
the 'BIG THREE' advantages

AND FOR
LOW-COST COAL
SAMPLE CRUSHING



The American Sample Crusher, with its new Adjustable Sampling Hopper, gives 5%, 10%, 15% or 20% of a sample . . . in one operation.

1 **BETTER REDUCTION.** The exclusive American Rolling Ring reduction principle . . . designed to *split* coal instead of crushing it. Result: *controlled uniformity* in all coal reduction.

2 **HIGHER TONNAGE.** A "big appetite" (up to 800 t.p.h., depending on size of feed and product desired) in a *compact unit* with minimum headroom requirements for easier installation.

3 **LOWER MAINTENANCE.** Not a mere claim, but actual performance, backed by the operation records of scores of coal mines and power plants all over the country—records that prove Americans operate at a *total cost of less than 1¢ per ton of coal crushed!*

● ***WANT MORE INFORMATION***
on better coal preparation?
Write for Bulletin AC.

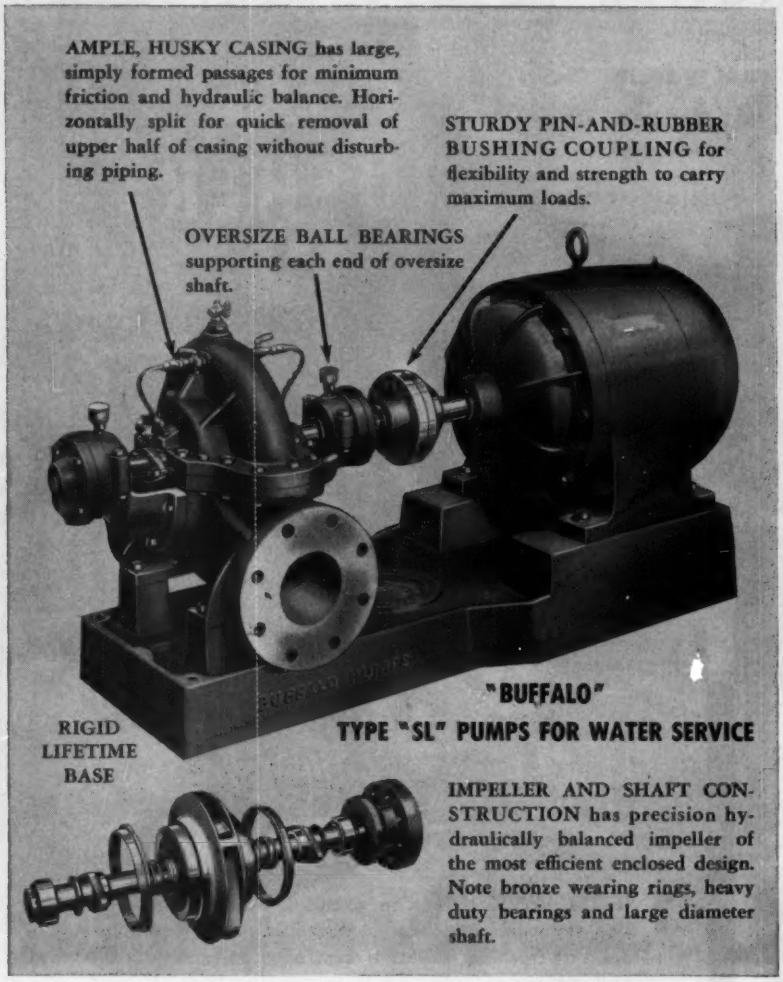
American
PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 MACKLIND AVE. • SAINT LOUIS 10, MO.

BUILT-IN ENDURANCE

KEEPS YOUR PUMPING COSTS DOWN!


AMPLE, HUSKY CASING has large, simply formed passages for minimum friction and hydraulic balance. Horizontally split for quick removal of upper half of casing without disturbing piping.
STURDY PIN-AND-RUBBER BUSHING COUPLING for flexibility and strength to carry maximum loads.
OVERSIZE BALL BEARINGS supporting each end of oversize shaft.
"BUFFALO"
TYPE "SL" PUMPS FOR WATER SERVICE
RIGID LIFETIME BASE
IMPELLER AND SHAFT CONSTRUCTION has precision hydraulically balanced impeller of the most efficient enclosed design. Note bronze wearing rings, heavy duty bearings and large diameter shaft.

These are a few of the "Q" Factor* design and construction details that mean money-saving efficiency, long life and low-cost maintenance when these "Buffalo" Double Suction Pumps are on your water jobs. Write for Bulletin 955-R for the full story of this better pumping value.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

"Buffalo" PUMPS

BUFFALO PUMPS

DIVISION OF BUFFALO FORGE CO.

488 Broadway Buffalo, N. Y.

Canada Pumps, Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

REPORTS from the FIELD

Begins on page 144

22nd National Power Show to have atomic section

► SPOTLIGHTING those two scientific prodigies, atoms in industry and automation, the ASME will hold forth with its own brand of show business at the N. Y. Coliseum on Nov 26-30.

The National Exposition of Power and Mechanical Engineering, twenty-second of its kind, returns to New York after a four-year absence.

The atomic section, newest feature of the exposition, is expected to produce news-making disclosures about the widening applications of nuclear physics. One display will show a model of the first privately financed critical facility and an environmental test capsule, said to be the only one available which controls temperature accurately in reactor environment.

Automation will come in for its share of the bows with an industrial tractor, guided entirely by electronic signals.

Some 250 leading manufacturers have already reserved space, and E K Stevens, manager, indicates a substantial influx of new applications. Plans filed with the management reveal that many advances in engineering design, never before available to exposition visitors, are being made ready.

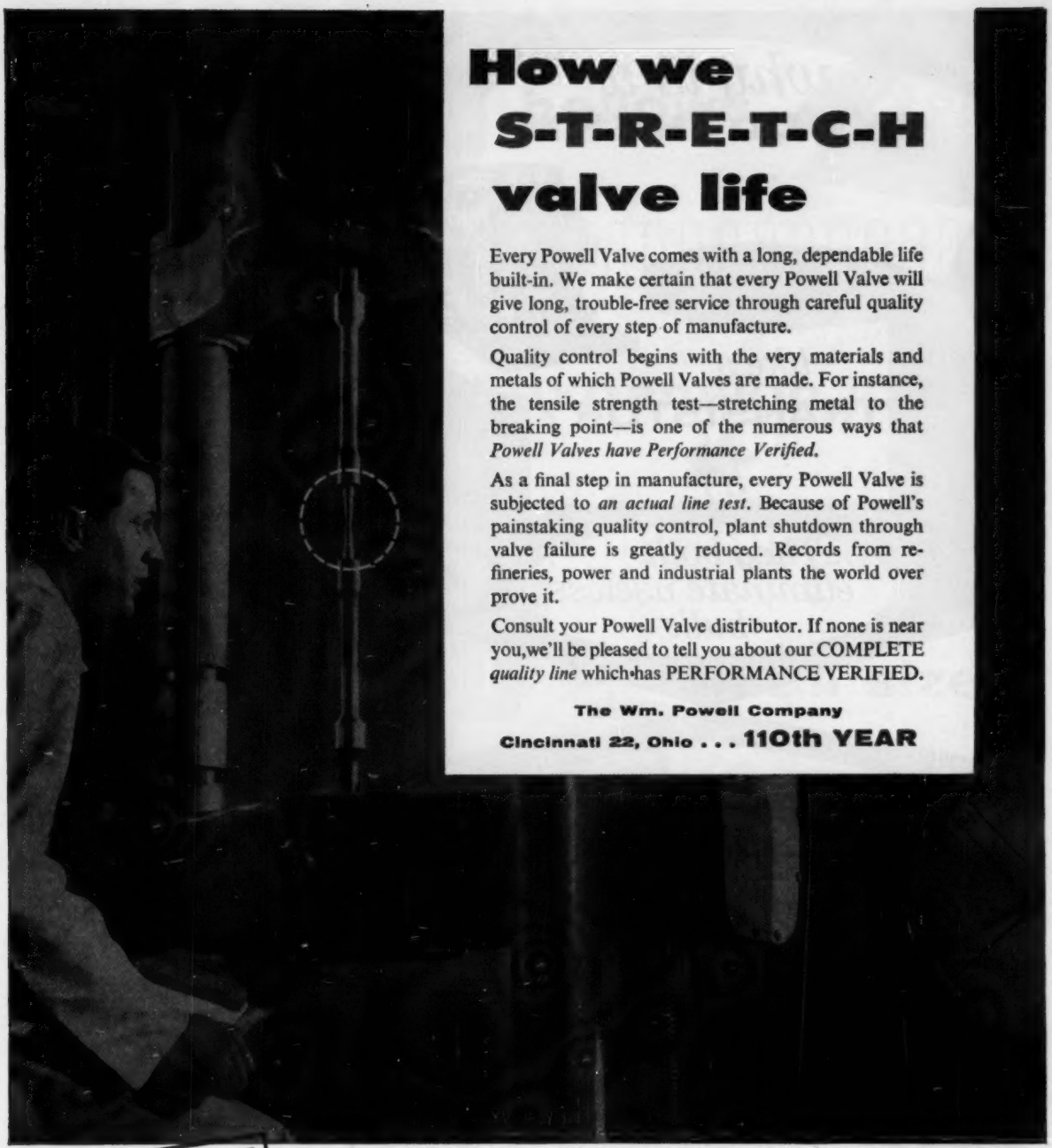
Electrical equipment will be strongly represented, not only in generation, but in a variety of motors and motor drives and supplementary applications in factory and field. There will be displays of cable testers, dielectric testing and cable fault-locating equipment, ac-dc converters, frequency changers and testing equipment, variable speed drives, diesel generating sets and others.

Wind tunnel tests full-scale engines at supersonic speeds

► MORE POWER than 60 locomotives is available to drive the new 10x10-ft supersonic wind tunnel of the National Advisory Committee for Aeronautics at the Lewis Flight Propulsion Laboratory, Cleveland, Ohio.

This power comes from the world's most powerful wind tunnel drive system—seven General Electric motors with a total rating of 250,000 hp continuously, and 300,000 hp for one-hour overload operation.

The tunnel's main drive has four wound-rotor induction motors mounted on a single shaft to turn the main compressor. Each motor is rated 37,500 hp at 875 rpm and uses 3-phase 60-cycle current at 6600 v. Three similar



How we S-T-R-E-T-C-H valve life

Every Powell Valve comes with a long, dependable life built-in. We make certain that every Powell Valve will give long, trouble-free service through careful quality control of every step of manufacture.

Quality control begins with the very materials and metals of which Powell Valves are made. For instance, the tensile strength test—stretching metal to the breaking point—is one of the numerous ways that *Powell Valves have Performance Verified.*

As a final step in manufacture, every Powell Valve is subjected to *an actual line test.* Because of Powell's painstaking quality control, plant shutdown through valve failure is greatly reduced. Records from refineries, power and industrial plants the world over prove it.

Consult your Powell Valve distributor. If none is near you, we'll be pleased to tell you about our COMPLETE *quality line* which has PERFORMANCE VERIFIED.

The Wm. Powell Company

Cincinnati 22, Ohio . . . 110th YEAR

PERFORMANCE PV VERIFIED

FIG. 11303 WE—1500-Pound Pressure Seal Steel Gate Valve.

FIG. 3059G—300-Pound Steel Lubricated Plug Valve. Gear Operated. Sizes 6" to 12".

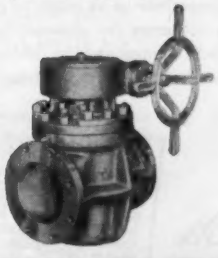
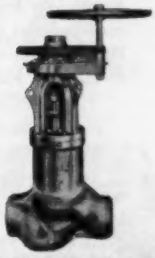


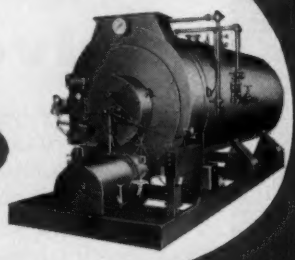
FIG. 19084 WE—900-Pound Pressure Seal Non-Return Globe Valve. Gear Operated.



POWELL VALVES

BRONZE, IRON, STEEL AND CORROSION RESISTANT VALVES.

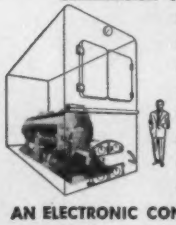
why is a CYCLOTHERM



like a TRANSISTOR?

...They both eliminate useless bulk

COMPACT—that's the word for today's radio, with modern transistor tubes replacing the big tubes of earlier days. And Cyclotherm, too,—the modern steam and hot water generator—is a case history in the elimination of useless bulk.



Saving up to one-third the space required by the ordinary boiler, Cyclotherm's exclusive, patented Principle of Combustion and Heat Transfer gives more horsepower per unit of weight, uniform heat transfer for every square foot of heating surface. Guaranteed to operate at a minimum of 80% efficiency, Cyclotherm gets more out of the fuel it burns, gives you substantial savings in gas or oil and in maintenance.

AN ELECTRONIC CONTROL SYSTEM operates Cyclotherm automatically. On 18 to 60 hp units, burner shuts down when steam demands are satisfied,

starts up when steam again is needed. On larger units, precision modulation keeps peak efficiency with boiler operating at from 30% to 100% of rated capacity. Many users report up to 50% savings in maintenance costs. Cyclotherm comes to you fully assembled and factory pre-tested. Needs only five simple connections to be ready to go. Many plants have installed two or more Cyclotherms for greatest flexibility and power. Burns gas or oil with quick changeover. In 18 to 500 hp models, 15 to 200 psi. Fill out coupon below and mail today.

YEARS AHEAD IN STEAM GENERATION

CYCLOTHERM®

STEAM AND HOT WATER GENERATORS

Cyclotherm Division
National-U. S. Radiator Corp.
2530 E. First St.
Oswego, N. Y.

Send me free copy of your full-information booklet on Cyclotherm Steam and Hot Water Generators.

Company .....
Name .....
Address .....
City .....Zone..State....

REPORTS from the FIELD

Begins on page 144

motors, rated 33,334 hp each, turn the secondary compressor.

The first compressor alone can drive the tunnel's air stream between two and two-and-a-half times the speed of sound. Above this range both compressors must be used.

The tunnel will be used for research and development testing of propulsion systems for aircraft and guided missiles by scientists of the Lewis Laboratory.

Calendar of Events

Sept 17-21 — Instrument Society of America, 11th Annual International Instrument-Automation Conference and Exhibit. New York Coliseum. Further information obtainable from ISA, 1319 Allegheny Ave, Pittsburgh 33, Pa.

Sept 17-21—American Society for Testing Materials, 2nd Pacific Area National Meeting and Apparatus Exhibit. Hotel Statler, Los Angeles, Calif. Details from ASTM, 1916 Race St, Philadelphia 3, Pa.

Sept 20-22—Institute of Power Engineers, Annual Convention. Royal Alexandra Hotel, Winnipeg, Manitoba, Canada. Details from IPE, 239 Linden Ave, East Kildman, Winnipeg 5, Manitoba, Canada.

Sept 24-25—Steel Founders' Society of America, Fall Meeting. The Greenbrier, White Sulphur Springs, W. Va. Further information from SFSA, 606 Terminal Tower, Cleveland 13, Ohio.

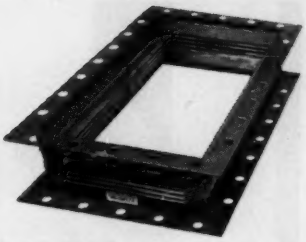
Sept 25-28—Association of Iron and Steel Engineers, 1956 Iron & Steel Exposition and Annual Convention. Public Auditorium, Cleveland, Ohio. Complete information obtainable from AISE, 1010 Empire Building, Pittsburgh 22, Pa.

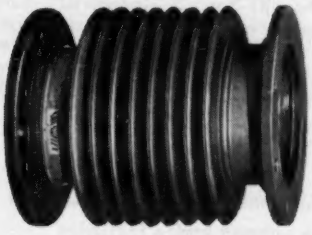
Oct 1-5—American Institute of Electrical Engineers, Fall General Meeting. Morrison Hotel, Chicago. Details from AIEE, 33 W 39th St, New York 18, N. Y.

Oct 8-10—American Society of Mechanical Engineers and **American Society of Lubrication Engineers,** 3rd jointly-sponsored Lubrication Conference. Chalfonte-Haddon Hall, Atlantic City, N. J. For details write ASME, 29 W 39th St, New York 18, N. Y. or contact ASLE, 84 E Randolph St, Chicago, Ill.

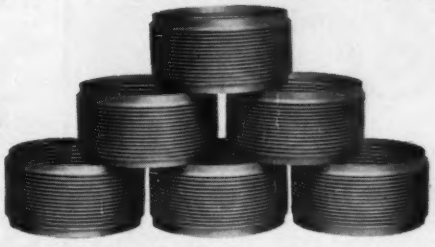
Oct 8-12 — American Society for Metals, 38th Annual National Metal Congress and Exposition. Public Auditorium and Exhibition Hall, Cleveland. Details from ASM, 7301 Euclid Ave, Cleveland 3, Ohio.

Oct 22-26—National Safety Council, 44th National Safety Congress and Exposition, Conrad Hilton, Congress, Morri-

Sola-Flex bellows 



and expansion joints

are made  in all sizes

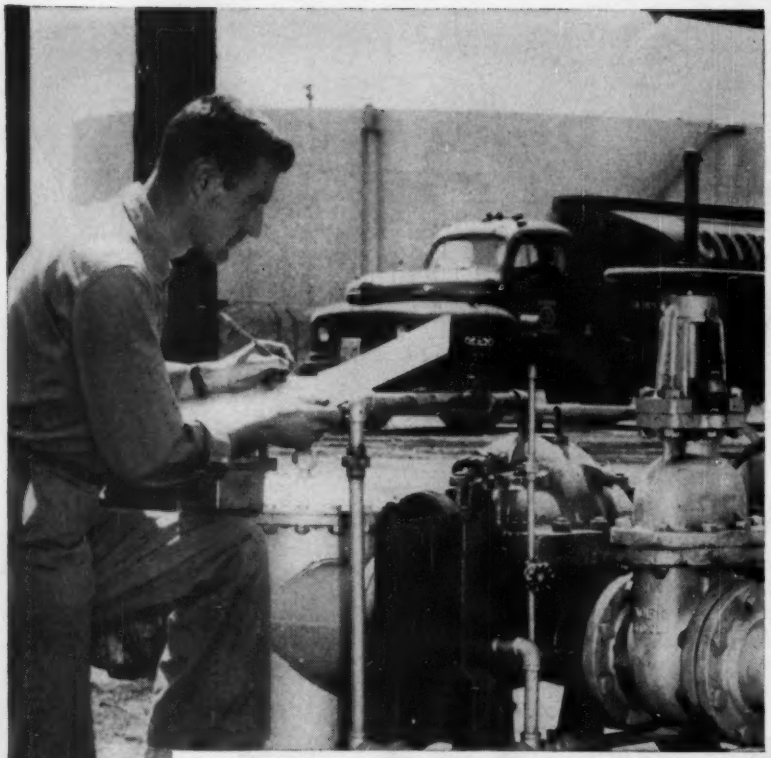
and varieties

SOLA-FLEX JOINTS AND BELLOWS

BIG OR LITTLE, round or square, convoluted or U-span—no matter what kind of expansion joints you need, Solar can build them. Sola-Flex joints are durable, economical, and are based on advanced engineering designs using a wide variety of metals. High or low pressure piping problems are easily solved with Sola-Flex bellows. Ask for our latest catalog. Write Dept. C-65, Solar Aircraft Company, San Diego 12, Calif.

SOLAR
AIRCRAFT COMPANY
SOLAR
SAN DIEGO DES MOINES

DESIGNERS, DEVELOPERS AND MANUFACTURERS OF METAL ALLOY PRODUCTS • GAS TURBINES • BELLOWS • CONTROLS • HIGH TEMPERATURE COATINGS • AIRCRAFT COMPONENTS



Pump capacity . . . ✔

If it's capacity you want, check the Goulds Fig. 3405 single-stage suction pump. You'll get capacity all right—*and much more!*

You can pump at any rate from 200 GPM to 6400 GPM with one of the 19 available sizes. And you can save money, too, because of these built-in cost advantages:

Interchangeability of parts—**Only three shaft and rotating-parts assemblies provide for 19 pump sizes and 38 pump combinations.**

Standard "custom" features—***Every* Fig. 3405 pump has sealed bearing housings, renewable stuffing box bushings, Teflon water seal rings, stainless steel impeller keys, cowl-type glands, die-formed stuffing box packing, and corrosion-resistant gland bolts.**

Compact construction—**Short bearing spans cut pump lengths as much as 50 percent—which means less floor space.**

Flexibility of stuffing box—**You can change from conventional stuffing boxes to mechanical seals in the field.**

Easy rotation change—**Its unique design permits you to change the direction of rotation in the field.**

When you check *capacity*, you'll find it in a Goulds Fig. 3405—and more besides. Call your Goulds representative or drop us a card. Ask for Bulletin No. 721.6.

MEMBER

Goulds PUMPS INC. Seneca Falls New York

Sales Offices: Atlanta • Boston • Chicago • Houston • New York Philadelphia • Pittsburgh • Tulsa

REPORTS from the FIELD

Begins on page 144

son and LaSalle Hotels, Chicago. Further information obtainable from NSC, 425 N Michigan Ave, Chicago 11, Ill.

Oct 31-Nov 2—Society for Experimental Stress Analysis, 1956 Annual Meeting and Exhibit. Deshler-Hilton Hotel, Columbus, Ohio. For details write to SESA, Box 168, Cambridge 39, Mass.

Oct 31-Nov 2—Industrial Management Society, 20th Anniversary National Time and Motion Study and Management Clinic. Sherman Hotel, Chicago. Details from IMS, 35 E Wacker Dr, Chicago 1, Ill.

Aluminum Company of Canada to expand hydro facilities

► CONSTRUCTION of an 800,000-hp hydro plant on the Upper Peribonka River in Quebec is soon to be started by the Aluminum Company of Canada Ltd. The project, to cost approximately $135 million, will be the third and largest plant to be built on the Peribonka by the company. One with 275,000-hp installed capacity went into operation in 1952; a 285,000-hp plant went on the line in 1953.

The new plant will be located a few miles below the existing storage dam, Passe Dangereuse—a main storage reservoir on the Upper Peribonka. A tunnel will run from this reservoir six miles downstream where a 636-ft head can be obtained for an underground power plant.

300,000-kw turbine-generator to have 98-ton base section

► PRODUCTION OF a 98-ton base section for the low-pressure element of the world's first 300,000 kw steam turbine-generator unit has been announced. The unit is the heaviest weldment produced to date for a steam turbine by Allis-Chalmers Mfg Co. It measures 12-ft high, 15-ft wide and 30-ft long.

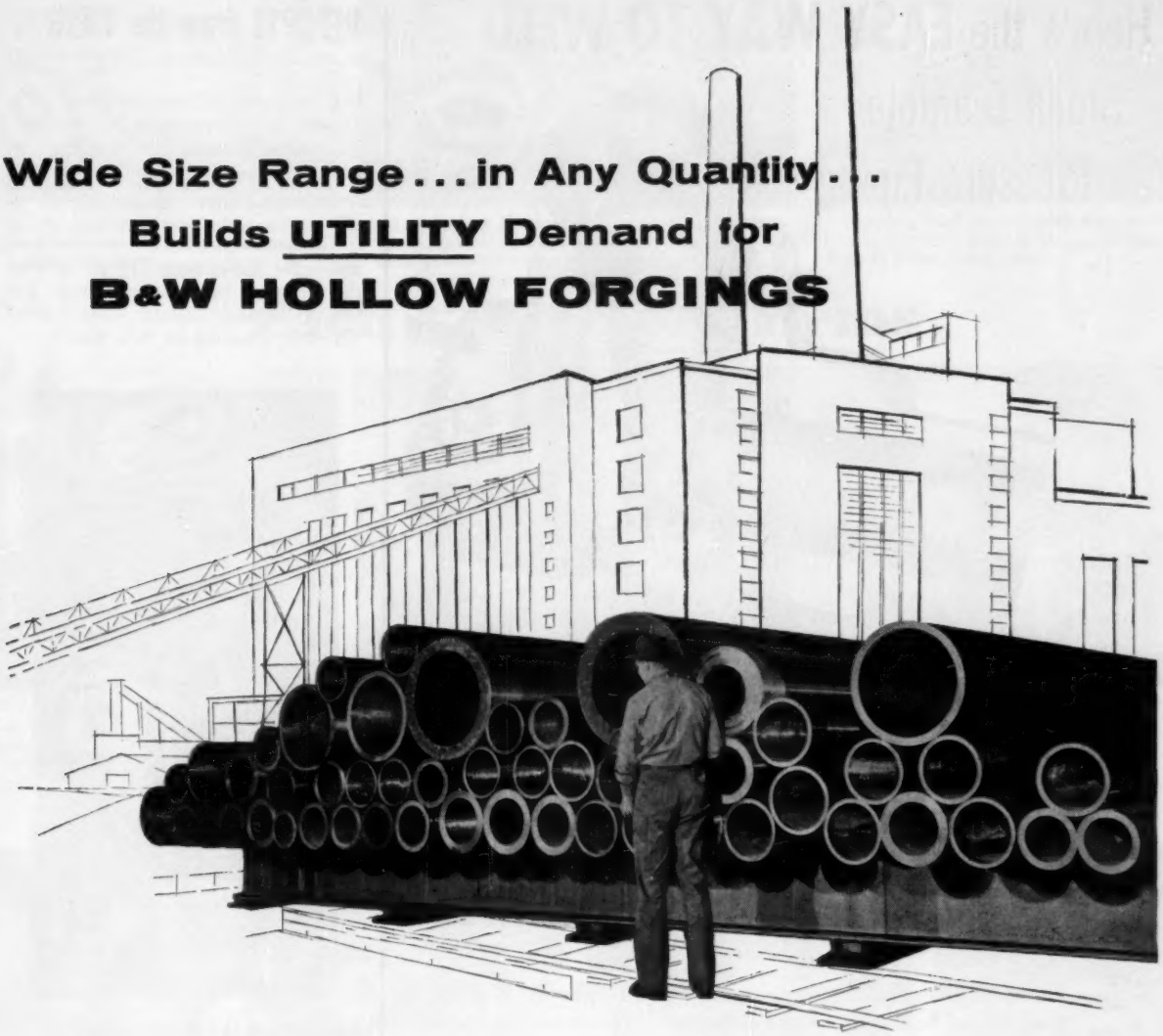
Steam turbine-generator unit being built for River Rouge plant of Detroit Edison Co will weigh 1615 tons.

Welding data book offered by Eutectic

► A 140 PAGE Pocket Data Book, featuring simplified welding procedures for every base metal has been issued by the Eutectic Welding Alloys Corp. The book covers 120 welding rods, electrodes and welding compounds.

Hundreds of applications for weld-

Wide Size Range . . . in Any Quantity . . .
Builds UTILITY Demand for
B&W HOLLOW FORGINGS

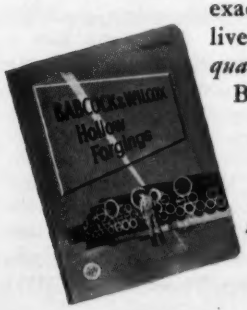


American Gas and Electric...Carolina Power & Light . . . Commonwealth Edison . . . and Wisconsin Electric Power, are typical of the leading Electric Utilities that use B&W Hollow Forgings for main steam, reheater, feedwater, and similar lines.

They find B&W Hollow Forgings offer a sound solution to their piping problems. Available in a wide range of sizes and material, these heavy-duty forgings can be specified to exact design requirements delivered right to the job, *in any quantity.*

Because they are made from high quality carbon, alloy and stainless steels, carefully produced under controlled conditions from the initial melt through final inspection, B&W Hollow Forgings offer the user savings in time and money.

Also, because of B&W's specialized manufacturing process, Hollow Forgings can be made to unusual design specification—either in special shapes or with special end preparations such as end closures, reduced sections, and Van Stone flanges. For additional information, write directly to The Babcock & Wilcox Company, Process Equipment Department, Barberton, Ohio.



Ask for this Bulletin: S-16B

BABCOCK & WILCOX

BOILER DIVISION

S-461

Here's the **EASY WAY TO WELD**

Small Diameter Pressure Piping

USE W-S FORGED STEEL SOCKET-WELDING FITTINGS

In addition to providing high strength and toughness, W-S Forged Steel Socket-Welding Fittings are also easy to install. Deep sockets support and align the pipe for welding... eliminating the need for tack welding or special fixtures. No back-up ring is needed either. The fillet-weld is completely outside the pipe. Welding icicles just can't form inside the pipe. The result is a clean, tight welded joint that will readily resist high pressures and the stresses of shock and vibration. What's more, installation costs are lower.

W-S Socket-Welding Fittings are available in sizes ⅛" to 4" for schedule 40, 80, 160 and double-extra heavy pipe in carbon steel, stainless steels and alloy steels.

For complete information on the installation and operation advantages of W-S Forged Steel Socket-Welding Fittings, send today for Bulletin A-3-56.

W-S FITTINGS DIVISION
H. K. PORTER COMPANY, INC.
Roselle, New Jersey

REPORTS from the FIELD

Begins on page 144

ing are given for every industry. The Data Book is designed to help foremen, purchasing agents and welders determine possibilities for saving time and money with easier, improved welding.

The pocket book is available free, under the designation TIS 2575, from the technical Information service, Eutectic Welding Alloys Corp, 40-40 172nd St, Flushing 58, New York.

Largest canned motor pump undergoes rigorous test

► SHOWN ON TEST, photo above, is the largest canned motor pump ever built —a 1600-hp Westinghouse unit. The first of three main coolant pumps being built for the 60,000-kw Pressurized Water Reactor at Shippingport, Pa., it has been undergoing rigorous performance tests since June, 1955.

The hermetically-sealed zero-leakage motor pump will circulate 18,300 gpm or more of radioactive water through the primary loop of the reactor at approximately 2000 psi and 500 F. Pressure rise across the pump at design point is 115 psi. The pump uses a 1200-kw 2300-v single-winding motor that can be connected for two speeds.

There are no external shaft seals in the pump, and suction and discharge nozzles are designed to be welded into the pipeline. Although pumped fluid is allowed to fill motor cavity, it is excluded from rotor and stator windings by corrosion-resistant sealing jackets in the magnetic gap. An external

For lowest cost steam generation, *General Electric,* Louisville, Ky., burns coal the modern way.

At *American Cyanamid,* Bridgeville, Pennsylvania, power system modernization saves the firm $100,000 a year.

Burning coal the modern way at *Pennsylvania RR's* Juniata shops in Altoona saves $500,000 a year.

Each year more firms

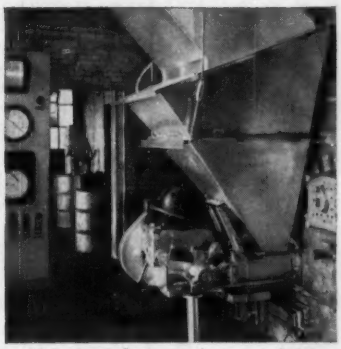
Carbide & Carbon, South Charleston, W. Va., saves $470,000 a year in lower costs and increased efficiency.

Coal costs 40% less than the next cheapest fuel at *Pinehurst, N. C.* resort . . . modernized plant 33% more efficient.

Modernization at *John Strange Paper Co.,* Menasha, Wis., reduced power costs and increased plant production 10%.

are burning coal the modern way

Modernization by *Clark Equipment Co.,* Battle Creek, Mich., supplies power for expanding production facilities, saves $7,500 annually.



Using modern equipment, *Scandinavia Belting Co.,* Charlotte, N. C., has increased steam capacity 150%, cut fuel costs 15% and reduced labor costs 70%.

Modernization gave *Kalamazoo Vegetable Parchment Co.,* Kalamazoo, Michigan, increased steam with lower fuel and operating costs.

Burning coal the modern way resulted in "peak efficiency and economy" for *Garlock Packing Co.,* Palmyra, New York.

for efficiency and economy

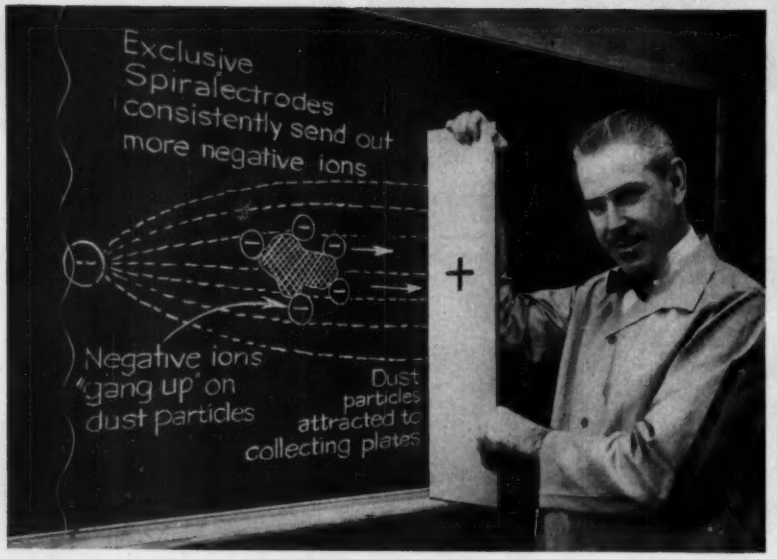
facts you should know about coal

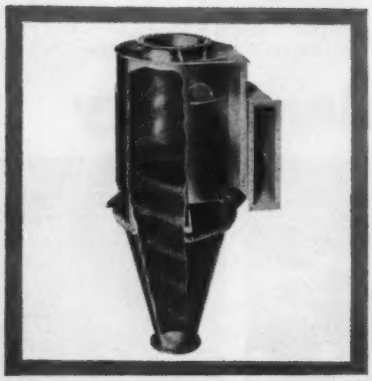
In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum • Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

NATIONAL COAL ASSOCIATION
Southern Building • Washington 5, D. C.

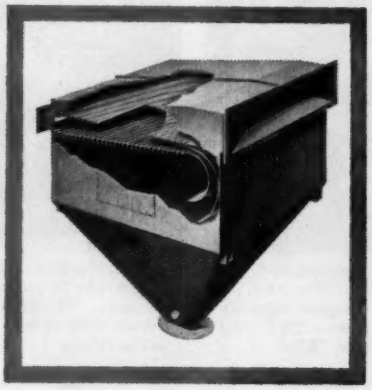
How a Buell Collection System "gangs-up" on dust to meet the toughest air pollution codes





With positive gas flow control for peak efficiency . . . plus continuous cycle rapping to completely eliminate puffing . . . Buell's "SF" Electric Precipitator "gangs-up" on dust (even dust with high resistivity) to permit full production even under the most rigid anti-air-pollution codes.

Buell Cyclones also deliver extra collection efficiency to "gang-up" on dust: Exclusive Shave-off design harnesses double-eddy current and really puts it to work.



Buell's Low Resistance Fly Ash Collector combines high efficiency to meet present day strictness, with low draft loss for natural or mechanical draft installations.

FOR THE COMPLETE STORY
Write:
Buell Engineering Company
Dept. 50-I, 70 Pine Street,
New York 5, New York

buell®

MECHANICAL ELECTRICAL

Experts at delivering Extra Efficiency in
DUST COLLECTION SYSTEMS

REPORTS from the FIELD

Begins on page 144

supply of ordinary clean water for cooling is the only auxiliary requirement.

Westinghouse, under contract to the AEC, is building the nuclear portion of the Shippingport plant. Duquesne Light Co is building the electric generating portion of the plant and will operate the entire station when it is completed in 1957.

American Power Conference set for Chicago

► THE 19TH ANNUAL American Power Conference, sponsored by Illinois Institute of Technology, in cooperation with 14 universities and nine technical societies, is scheduled for the Hotel Sherman in Chicago on March 27-29, 1957.

The conference provides a forum for the discussion of problems and exchange of information concerning the electric power industry and associated activities.

Conference director is Dr R A Budenholzer, professor of mechanical engineering at Illinois Tech.

Canadian hydro contract to Dominion Bridge Co

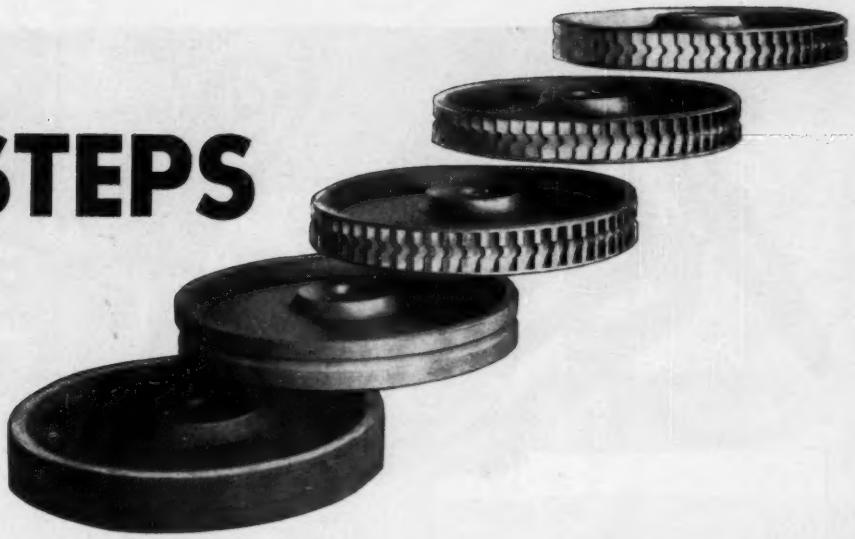
► A CONTRACT for mechanical equipment, one of the largest ever granted, has been awarded to the Dominion Bridge Co, Ltd. The contract was granted by the Hydro-Electric Power Commission of Ontario for the Canadian half of the Barnhart Island powerhouse in the International Rapids section of the St. Lawrence River.

Dominion Bridge is to design and fabricate 48 head gates together with hoisting equipment and embedded parts. These gates, designed to operate under a head of 93 ft will be 17 ft wide and 37-ft high.

When completed in 1960, this joint international $600 million development, being built in conjunction with the Seaway, will develop 2.4 million hp. It will be used by the Power Authority of the State of New York and the Hydro-Electric Power Commission of Ontario.

National Bureau of Standards' Washington, D.C. laboratories will be relocated near Gaithersburg, Maryland. The move was decided upon after it was determined that renovation of the present plant, on Connecticut Avenue in Washington, would amount to more than half the cost of an entirely new facility. Transfer of operations to the new location is expected to be completed in about five years.

5 STEPS



in making an almost indestructible turbine

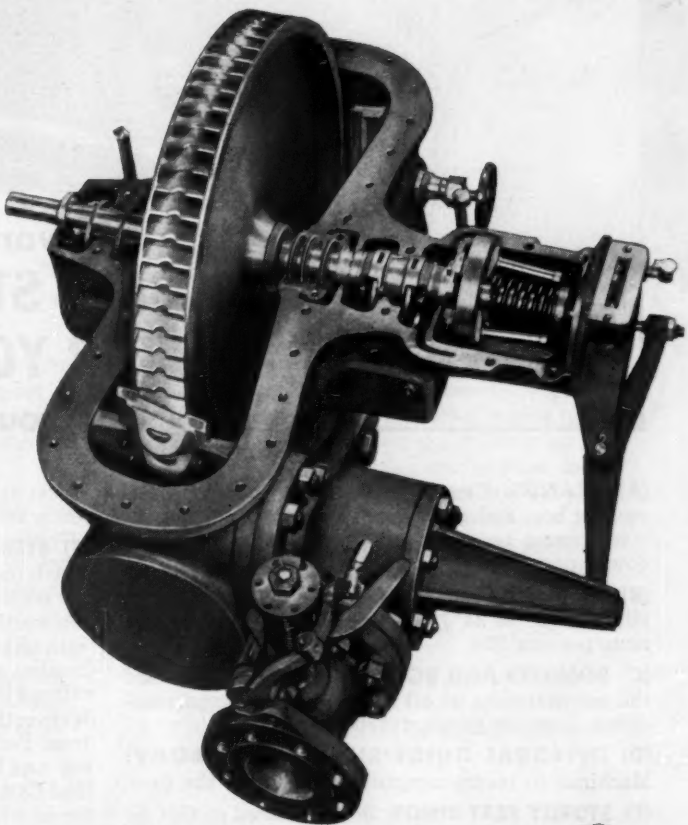
The rotor of a Terry solid-wheel turbine is a single forging of special composition steel. It is first rough turned in two operations, as shown, and then two cuts are taken to mill the semi-circular buckets from the solid metal. The wheel at the top has been finished, ready for mounting on the shaft. *The result is a single-piece wheel with no parts to loosen or wear out.*

Blade wear, which might occur after many years of usage, is not important, because the power-producing action of the steam takes place on the curved surfaces at the backs of the buckets. Thus wear does not materially affect horsepower or efficiency.

The blades can't foul. They have a one-inch clearance, and are further protected by the projecting rims at the sides of the wheel.

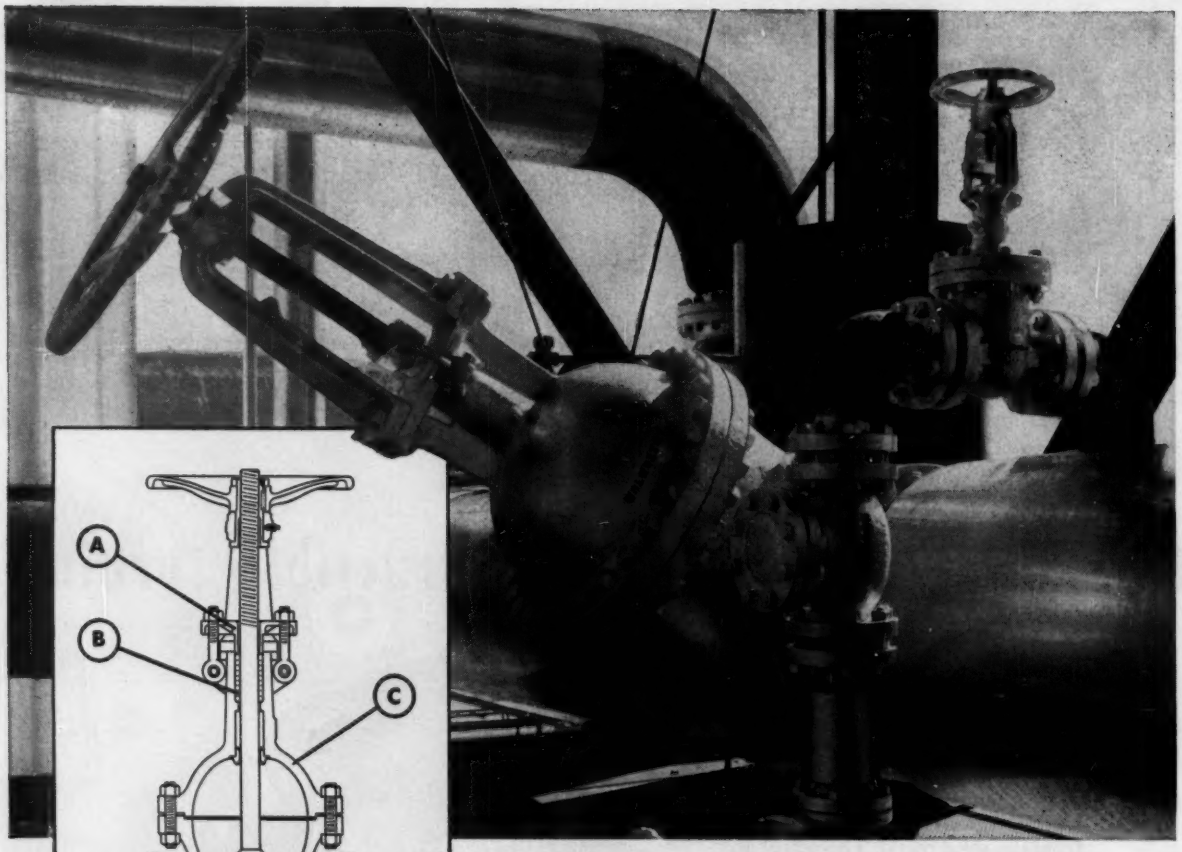
The Terry solid-wheel turbine is an extremely reliable piece of equipment. Write for details—today. Ask for a copy of bulletin S-116.

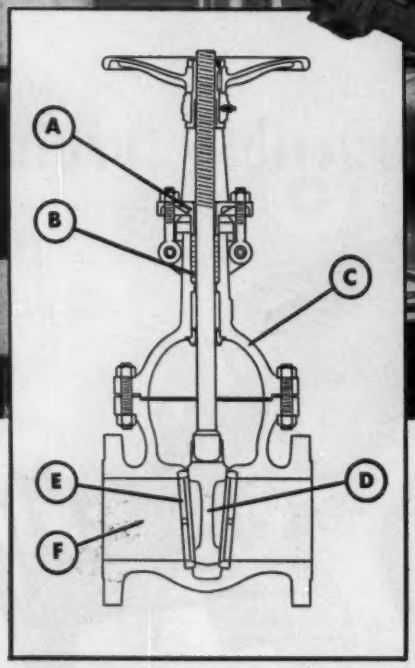
THE
TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.



TERRY

TT-1204





Walworth Series 150 and 300

CAST STEEL GATE VALVES OFFER YOU THESE FEATURES

for 'round-the-plant service

(A) GLANDS: Clearances between the gland and stuffing box, and gland and stem, are such that the stem cannot be scored even if the gland is pulled down unevenly.

(B) DEEP STUFFING BOXES: More than adequate in all sizes (2″ to 24″) to assure tightness and maximum packing life.

(C) BONNETS AND BODIES: Engineered to exceed the requirements of all applicable codes and standards. They are tough, durable, dependable.

(D) INTEGRAL GUIDE RIB FACES IN BODY: Machined to insure accurate centering of the gate.

(E) STURDY SEAT RINGS: Bottom-seated so that no recess exists at the back of the ring to cause turbulence, erosion and pressure drop.

(F) STREAMLINED PORTS: Permit unobstructed flow which results in minimum pressure drop and reduces the possibility of erosion.

Walworth Cast Steel Gate Valves can be furnished with either flanged ends or butt welding ends. Roller bearing yokes are available on the larger sizes. On valves 4 inches and larger, by-passes can be furnished. Walworth Cast Steel Gate, Globe and Check Valves from Series 150 to 2500, are available. For Series 600 and higher, we recommend Walworth Pressure Seal Cast Steel Valves. See your Walworth Distributor or write to Walworth for complete information.

WALWORTH

60 East 42nd Street, New York 17, New York

SUBSIDIARIES: ALOYCO ALLOY STEEL PRODUCTS CO. CONOFLOW CORPORATION M&H M & H VALVE & FITTINGS CO.
SW SOUTHWEST FABRICATING & WELDING CO., INC. WALWORTH COMPANY OF CANADA, LTD.

In
POWER
STATIONS or
CARGO
SHIPS...

EDISON OMNIGUARD IMPROVES OPERATING EFFICIENCY

Whether you're seeking more production from electric power stations and plant equipment or greater safe speed from seagoing vessels, you will find Omniguard can help you get more efficiency from your present equipment.

Many operators are already using Omniguard, the unique temperature indicating and alarm system designed by Thomas A. Edison, Inc., as the best means of eliminating waste due to downtime, repairs and lost production.

Omniguard improves plant efficiency and lets you operate at peak capacity because it unfailingly reports when dangerous temperature conditions occur at one or more points. And does it at surprisingly low cost.

A modular system of monitoring one to an unlimited number of points simultaneously, Omniguard watches continuously. When a bearing starts heating up or a process becomes critically hot, it automatically gives a warning and/or shuts down the equipment before it is damaged.

The low cost unit is easy to install. It is non-electronic and simplifies installation and maintenance through the use of copper wiring between all components.

See for yourself. A personal demonstration can be arranged at your own plant. Take it apart. Analyze it. Find out how simply Omniguard improves operating efficiency. Just write!

Thomas A. Edison

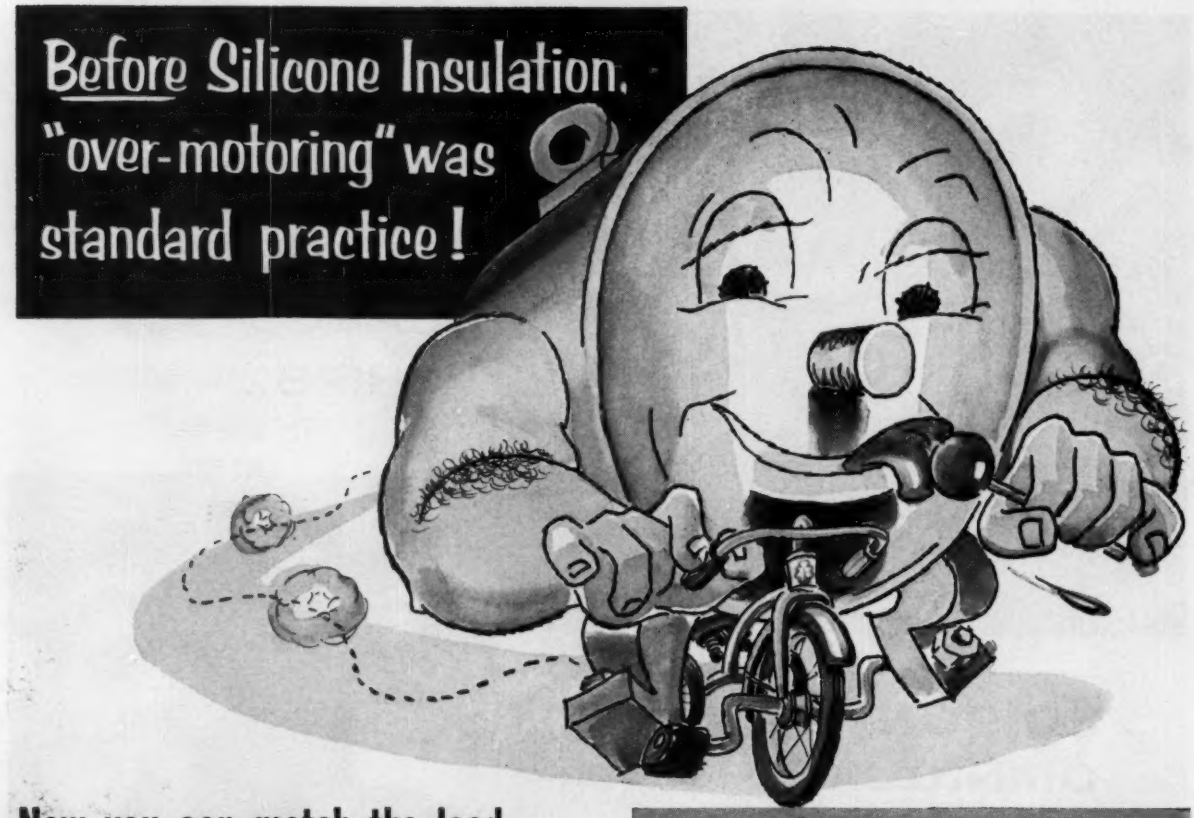
A GREAT NAME CONTINUES GREAT NEW ACHIEVEMENTS

Thomas A. Edison

INCORPORATED

INSTRUMENT DIVISION • 41 LAKESIDE AVENUE • WEST ORANGE, NEW JERSEY

Before Silicone Insulation, "over-motoring" was standard practice!



Now you can match the load . . . let silicones carry the overloads

Lazy motors cost money! Why continue to pay a fat premium for motors that make kid's play of their average work load? Today, you can save money by using *silicone insulated* motors rated to *match your average load.* Their built-in service factor of 25 to 50% will handle most intermittent overloads or loads that can't be matched in standard frame sizes.

Cut your capital investment and installation costs! Think of it—for every dollar dumped into *unused* motor capacity, you spend an extra $3 for starters, cable, transformer capacity and installation costs.

Enjoy more continuous production! You can depend on motors insulated with Dow Corning silicones to have maximum resistance to such motor killers as heat, moisture and corrosive atmospheres.

Remember, over-motoring is outmoded

Get sources for silicone insulated equipment—mail coupon today

Dow Corning Corporation, Dept. 6909, Midland, Mich.

Please send me sources of supply for new Silicone (Class H) ☐ Motors ☐ Transformers

NAME _____ TITLE _____

COMPANY _____

STREET _____

CITY _____ ZONE ____ STATE _____

Rolling up more evidence...

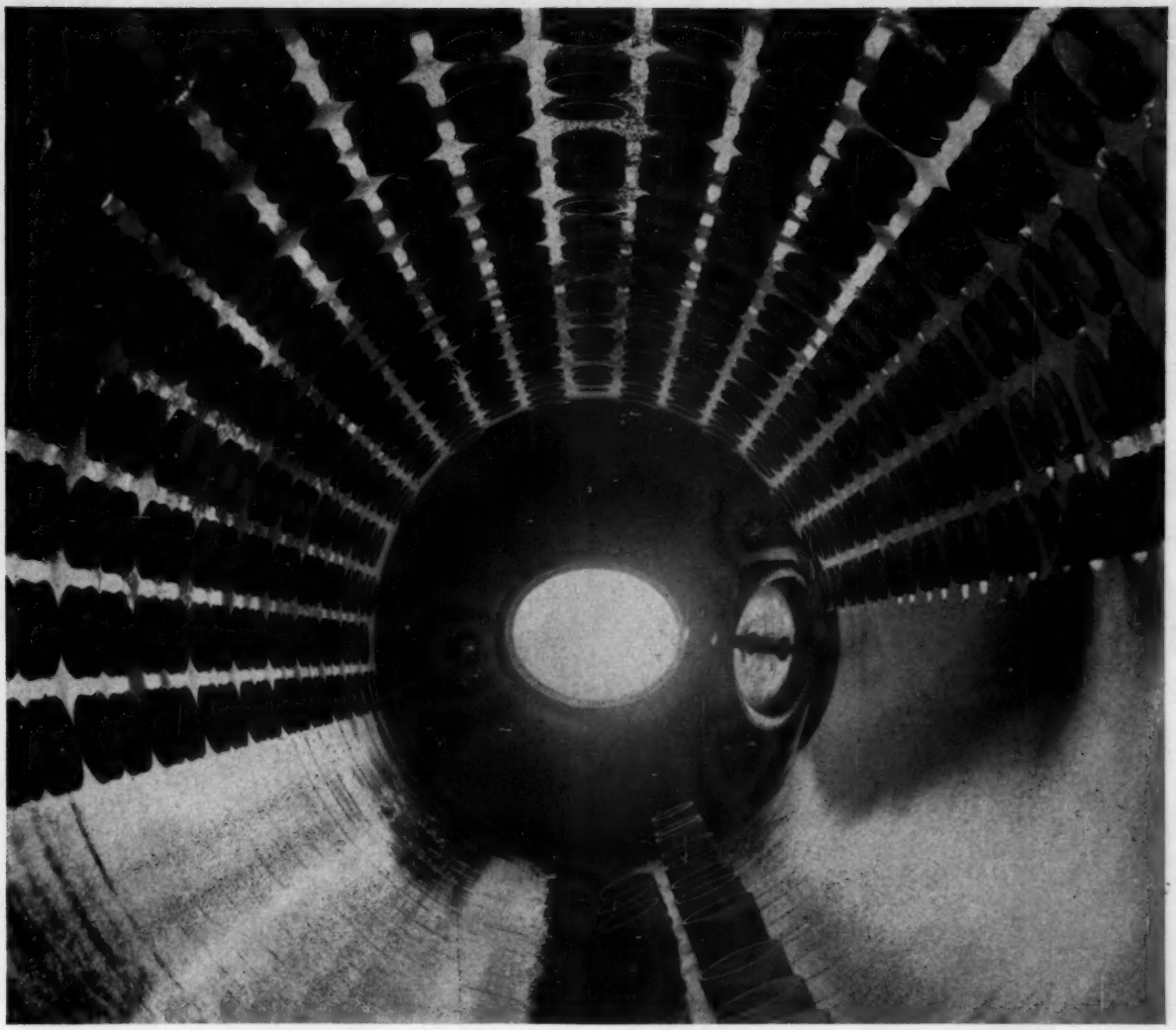
R. G. LeTourneau, Inc. of Longview, Texas, installs a silicone insulated d-c motor in each of the 24 electric wheels of the giant "Sno-Freighter." Silicone insulation is used to give maximum power per pound under tough operating conditions. The silicone insulated motors, located in tubular axles and connected through a gear train in the wheel hubs, demonstrate the advantages of placing the power unit close to the work . . . a basic principle made practical by the heat stability of Dow Corning silicone dielectrics.

DOW CORNING SILICONES

DOW CORNING CORPORATION
MIDLAND, MICHIGAN

ATLANTA • BOSTON • CHICAGO • CLEVELAND • DALLAS
DETROIT • LOS ANGELES • NEW YORK • WASHINGTON, D. C. (Silver Spring, Md.)

CANADA: Dow Corning Silicones Ltd., Toronto
GREAT BRITAIN: Midland Silicones Ltd., London
FRANCE: St. Gobain, Paris



Mud drum interior of Boiler No. 9, American Motors Co., Kenosha, Wis.

NO TROUBLE HERE...

When the mud drum of Boiler No. 9 was drained and opened for inspection recently, the interior looked exactly the way everyone expected it would—clean as a whistle. After nine months of service there was no sludge or scale to impair steam production efficiency.

This kind of trouble-free performance and the continuous production of high-purity steam are direct results of Dearborn Water Conditioning—a properly balanced program that combines quality products with the right methods, controls, and technical supervision.

Power Engineers in leading industrial plants throughout the country place their confidence in Dearborn methods and products. A Dearborn Water Conditioning program in your power plant is your assurance of maximum operating efficiency—and your insurance against unnecessary maintenance expense and costly shutdowns caused by sludge, scale or corrosion.

Let a Dearborn Water Treatment Engineer survey your system and recommend control methods best suited to your needs. We'll gladly make the call at your convenience.

USE THE COUPON

Dearborn Chemical Company, Dept. PO,
Merchandise Mart Plaza, Chicago 54, Ill.

☐ Please have a Dearborn Engineer call.

☐ Send complete details on Dearborn Water Conditioning Program.

Name.....*Title*.....

Company.....

Address.....

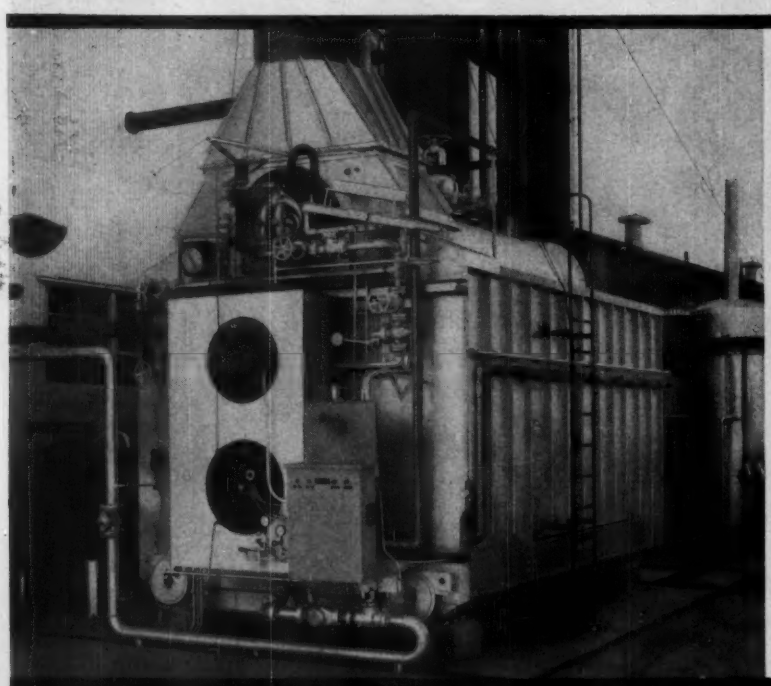
City.....*Zone*.....*State*.....

Dearborn®

...a leader in water conditioning and corrosion control since 1887

UNION PACKAGED BOILERS

give Tri-Valley the steam it needs to pack 3,200,000 cases of canned food



30,000 lbs. of steam per hour — that's the capacity of this Union Type MH Steam Generator serving Tri-Valley's San Jose cannery. It's part of a complete boiler plant designed and constructed by Union's West Coast affiliate, Union Iron Works of California, Inc.

PEAR-LADEN CONVEYORS keep production on the move inside Tri-Valley's San Jose plant.

BIRD'S EYE VIEW of Tri-Valley's Modesto plant which utilizes a 30,000 lb./hr. Union Packaged Boiler for process steam.

Producing 24 varieties of canned foods, Tri-Valley Packing Association is one of California's largest independent canners. In 1955, it packed 58,000 tons of raw fruits and vegetables... *3,200,000 cases!*

Providing steam for the canning process as well as for operating cannery process equipment in each of Tri-Valley's two recently-modernized plants is a 30,000 lb./hr. Union Type MH Packaged Steam Generator.

In 1953, Tri-Valley's first MH Unit went to work in the Modesto plant. When the Association's San Jose plant needed a new boiler in 1955, another Union MH Packaged Boiler was picked for the job. Says Tri-Valley, "Our selection was based upon our evaluation of the design... and the performance of the Union MH Packaged Boiler installed in our Modesto plant."

The efficiency of the new Union Generator at the San Jose plant has been checked at 77.88% on gas firing at 33,000 lbs./hr., which is 10% over rated maximum continuous output.

From coast to coast, Union Packaged Steam Generators are stacking up impressive job records in chemical processing plants, pulp and paper mills, breweries, refineries, institutions, schools and hospitals, to name but a few.

Completely shop-assembled at Union Iron Works for delivery via rail or truck, Type MH Units can be equipped to handle multitudes of needs formerly requiring costly field erection and special engineering. Standard units are designed in 13 sizes from 10,000 to 50,000 lbs. of steam per hour.

GET THE FULL STORY including cut-away illustrations, tube layouts and dimension tables by writing for Bulletin MH-353.

UNION

UNION IRON WORKS

ERIE, PENNSYLVANIA

In the PINK of Condition

CHAPMAN MOTOR UNITS

We've done one thing for you. Chapman's Motor Units . . . for operation of valves, floorstands and sluice gates . . . are in the best of condition for accurate performance and longer, lower cost life.

We've made them as you like them . . . simplified them . . . streamlined them . . . taken off all the fat. In fact, when you look at a Chapman Motor Unit today, you can only find approximately *half as many parts* as on any other unit.

This simplicity, combined with Chapman's traditional ruggedness, means less trouble and lower maintenance over a longer period of smooth, accurate performance.

How can you go wrong? With Chapman Motor Units, the simplified design . . . the sturdy construction . . . mean no drift; less slash, accurate micrometer-controlled limit switch for predetermined seat tightness; quiet motor driven operation at all *times*. All at the lowest overall cost.

No trouble with operating positions. Operation is assured at any angle. Rugged stub-tooth gears need no grease or oil. No trouble with operating conditions. All units are weatherproof . . . *steam tight*. No trouble even with installations. When used with floorstands they are completely wired at the factory . . . ready to connect with your leads. Easy and simple to install.

Get our new catalog . . . Catalog 51 . . . on Chapman motor units today.

The Chapman Valve Manufacturing Co.
INDIAN ORCHARD, MASSACHUSETTS

Taylor shows you 6 ways TO CUT COSTS

1. TAYLOR INDUSTRIAL THERMOMETER

Ideal wherever an accurate check is needed on recording or controlling instruments. Available in many standard ranges and mounting angles. BINOC* tubing makes it 3-times-easier-to-read.

2. NEW BI-THERM* DIAL THERMOMETER

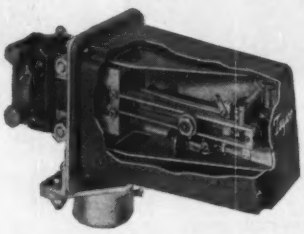
An easy-to-read, inexpensive, reliable thermometer, ideal for pipe line and storage tank service. 3″ or 5″ dials, 4″, 6″, 9″, and 12″ stems. Separable wells. Accurate to ±1% of scale because unaffected by ambient temperatures. Range limits minus 40 to plus 750°F.

3. FULSCOPE* RECORDING CONTROLLER

For desuperheaters, or for any close, accurate control of temperature, pressure, flow or liquid level. Quickly adapted to operating requirements.

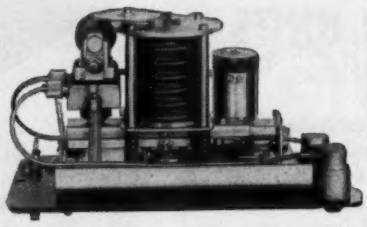
4. TAYLOR 6″ DIAL INDICATOR

For temperature and pressure measurements. Has an all-new design movement for greater sensitivity on any type of measuring job. New case can be flush or face mounted, is fume and moisture proof. Big selection of standard ranges.



5. TRANSAIRE* DIFFERENTIAL PRESSURE TRANSMITTER

A rugged, dependable and accurate instrument designed to measure flow, liquid level or specific gravity. Taylor's latest addition to TRANSET* System of transmitters, receivers and controllers.



6. TRANSAIRE TEMPERATURE TRANSMITTER

Compact and super-responsive. Designed to measure and transmit smallest temperature changes up to 1,000 feet with great accuracy. Provides dynamic accuracy, thanks to derivative action in the measuring circuit. Similar instruments for highly accurate pressure measurement.

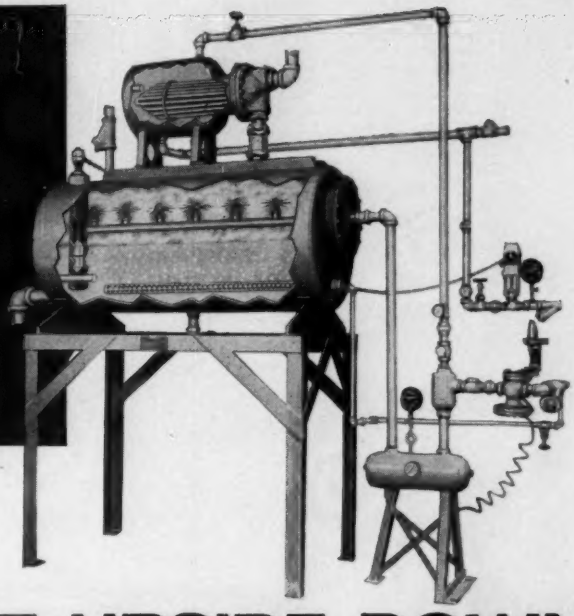
These Taylor instruments have been successful for years in helping to reduce costs, and maintain efficiency of expensive equipment. They are accurate, and for all their sensitivity, are remarkably rugged. An experienced Taylor Field Engineer will be glad to talk over your particular cost control problems . . . and show you how Taylor instruments can help solve them. Write to Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

*Reg. U.S. Pat. Off.

Taylor Instruments **MEAN ACCURACY FIRST**

SCHAUB

ZERO-OXYGEN DEAERATOR



TURNING AN OLD PRINCIPLE UPSIDE DOWN

Comes Up with a Better, Simpler Deaeration System

That is exactly what Schaub engineers did when they first designed the Schaub Zero-Oxygen Deaerator.

THE RESULT: An entirely new and simpler kind of boiler feedwater deaerator that insures complete oxygen removal (to .005 cc/liter) under all conditions and wide load variations—with excellent thermal economy. Add to this, lowest maintenance, plus complete safety and utmost dependability.

Basic differences that give Schaub Zero-Oxygen Deaerators their more effective performance are: 1) *external pre-heating* to a temperature *well above* boiling point within the deaerator; 2) explosive flash-down release of dissolved gases; 3) *unrestricted venting* through a special type vent condenser for faster *complete* release of liberated gases, without wasteful excess steam vapor losses.

By delivering *superheated* water into the fully vented tank, the hitherto critical problem of "matching" temperature to the *"full"* boiling point at the pressure within the deaerator is entirely eliminated. (This has been a major stumbling block with conventional deaerator design.) Passing through multiple, specially designed spray nozzles, incoming water "flashes down" in an explosive action that effectively liberates oxygen, CO_2 and all other non-condensible gases.

Also with unrestricted venting there is no need for premium-cost pressure shell. No pressure relief valve, overflow trap or orifice adjustment is ever required. Rust-proof Chromosoid lining insures extra-long life.

Before you plan any installation or addition of deaerating capacity get the full facts on all the performance advantages proved by the Schaub method. Ask your Schaub representative, or write for Bulletin 575.

FREE FACTS! MAIL THIS COUPON FOR COMPLETE DATA

FRED H. SCHAUB ENGINEERING CO.

2105 South Marshall Boulevard Chicago 23, Illinois

FRED H. SCHAUB ENGINEERING COMPANY
2105 South Marshall Boulevard, Chicago 23, Illinois

Please send me without cost or obligation my personal copy of your new Bulletin 575 on Boiler Feedwater Deaeration theory and practice.

Name_____

Company_____

Address_____

City_____ Zone_____ State_____

Jeffrey puts VIBRATION to useful work

YOU CAN SOLVE many flow-control problems with Jeffrey Electric Vibrating Feeders. They provide highly efficient regulation of the flow of coal from hoppers and bins to conveyors, elevators, crushers, jigs and so on. Coal is propelled in a smooth, continuous stream by each forward vibration stroke.

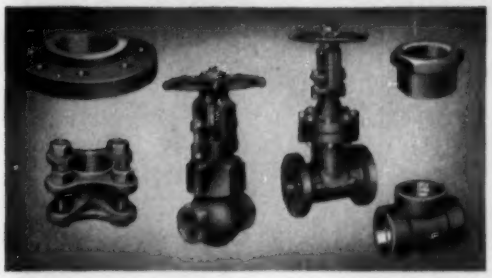
Balanced vibration in the Jeffrey system matches electrical frequency to the natural mechanical frequency of the driven equipment. This makes the system economical to operate, since all available energy does useful work. It is easy to control, safe, quiet and dependable. Vibration is isolated within the conveyor by scientifically designed supports.

Jeffrey's years of experience with conveying problems enable us to furnish systems exactly right for each particular task. Catalog 870 describes the complete line of Jeffrey Vibrating Equipment. For a copy, and for help on your conveying problems, write The Jeffrey Manufacturing Company, Columbus 16, Ohio.

JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT • TRANSMISSION MACHINERY • CONTRACT MANUFACTURING

Designed for today's *Tough* service demands



DROP FORGED VALVES AND FITTINGS FOR TOUGHNESS AND TROUBLE-FREE SERVICE

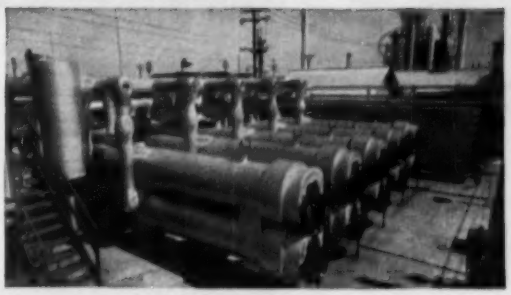
Drop forged from carbon and alloy steels, Vogt valves, fittings and flanges will safely handle liquids and gases at high pressures and high temperatures in power plants, chemical plants, petroleum refineries, etc.
The complete line includes flanged, screwed and socket weld end globe, gate and check valves—ells, tees, and crosses—couplings—bushings—plugs—unions—flanges and flange unions—and welding heads.

MODERN STEAM GENERATORS

Vogt steam generators are designed to give maximum rating in a minimum of space, with high efficiency and low maintenance expense. Bent tube types and straight tube, forged steel sectional header types to burn solid, liquid or gaseous fuels meet every power, process or heating requirement.

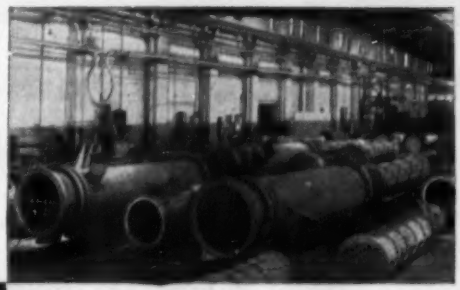
PROCESS EQUIPMENT FOR EVERY SERVICE

Vogt constructs process equipment in wide variety to all Codes. Stills and towers, oil chillers, crystallizers, heat exchangers, molding machines, etc., serve in the manufacture of oils, greases, 100 octane gasoline, synthetic rubber, chemicals and related products around the world.



SPECIAL MATERIALS COMBAT CORROSION AND PRODUCT CONTAMINATION

Our modern shops produce a wide variety of equipment from special metals and alloys to fight corrosion and product discoloration or contamination. Fabrication procedures insure that corrosion resistant properties of welds will match that of the materials used to construct the equipment.



MORE REFRIGERATION TONNAGE AT LESS COST

More than 70 years of engineering and manufacturing experience is incorporated in Vogt refrigerating and ice making equipment. Absorption Systems, Compression Systems, and Tube-Ice Machines in a wide range of capacities serve industrial and processing plants, and institutions, here and abroad.

Vogt

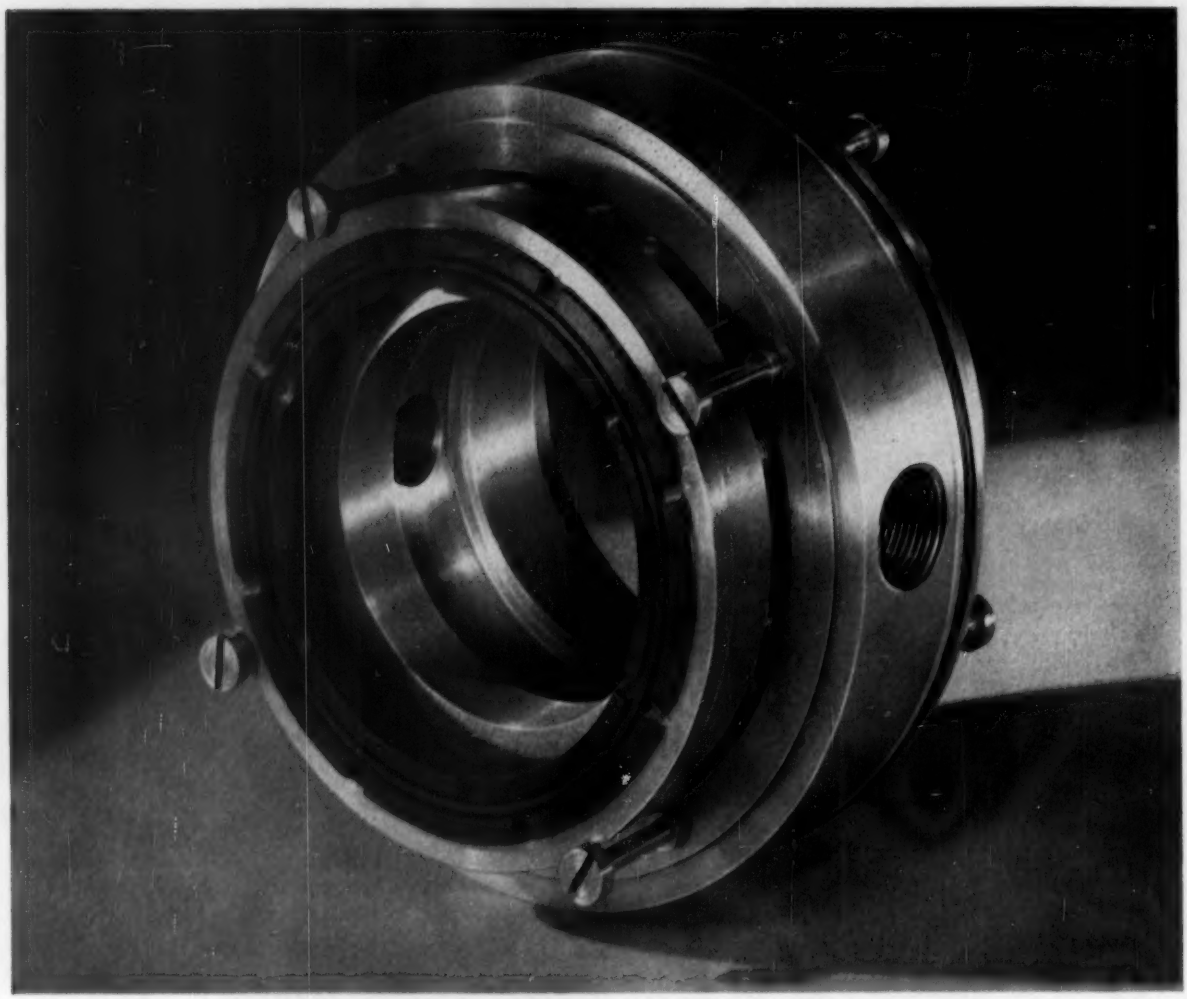
PRODUCTS

FOR REFINERIES, CHEMICAL PLANTS POWER PLANTS AND PROCESS INDUSTRIES

Write Dept. 24-GP for catalogs

HENRY VOGT MACHINE CO.
LOUISVILLE 10, KY

SALES OFFICES: New York, Philadelphia, Chicago, Cleveland, St. Louis, Charleston, W. V., Cincinnati, Dallas



Koppers Face Type Seal Provides Up to 20,000 Hours of Service!

Up to 30,000 Hours in Laboratory Tests Using Clean Gas!

Koppers engineering has created an unmatched sealing surface that gives Koppers Face Type Seals a much longer-than-ordinary service life.

The exclusive design of the sealing surface keeps pressure distribution and hydraulic balance unchanged during operation . . . permits a light face loading which lowers interface temperatures. Hydraulic balance allows sealing of gases and liquids through a wide range of rubbing speeds. Rugged construction adds to Koppers long service life. Rotating collars can be of hardenable stainless steels, cutlery and die steels, Stellites, or of a hard chromium or carbide face. Ring is of carefully selected grades of carbon.

If you have a sealing or piston ring problem, Koppers entire research, production and engineering facilities are at your disposal. For more details, write to the KOPPERS COMPANY, INC., 2109 Hamburg St., Baltimore 3, Maryland.

Koppers Company, Inc.
Metal Products Division
Piston Ring and Seal Dept.

***Engineered* Products**
Sold with *Service*

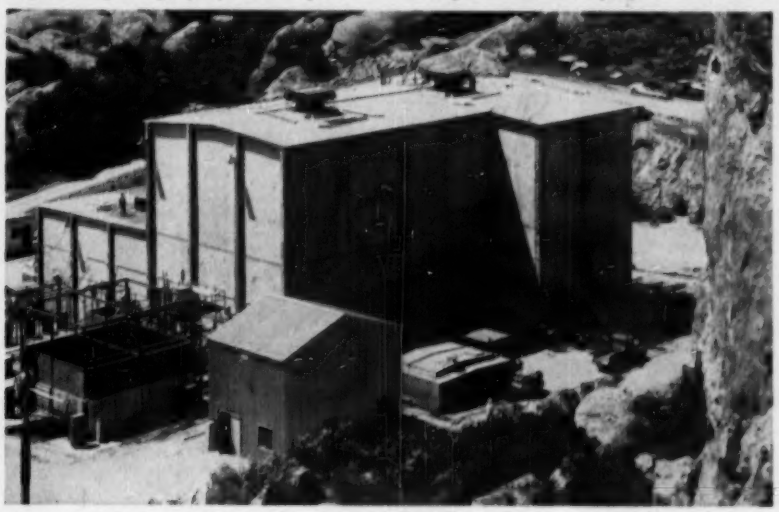
KOPPERS®

MECHANICAL SHAFT SEALS

NUCLEAR NEWS FROM ATOMICS INTERNATIONAL

Nuclear reactors now being built for science and industry—for power and radiation

Within a single decade ATOMICS INTERNATIONAL engineers and scientists have developed a broad range of experience in the nuclear field through the design, construction and operation of a wide variety of reactors. This work includes four reactors completed and now in operation; four more reactors now in construction; and seven major engineering design projects completed.



Sodium Reactor Experiment nears completion in Santa Susana Mountains. It is being built and will be operated by Atomics International as a key part of AEC's nuclear power development program.

ATOMICS INTERNATIONAL, a division of North American Aviation, Inc., is a leader in the development of advanced reactor technology. A new power reactor concept, the Organic Moderated Reactor Experiment, is scheduled to be built by ATOMICS INTERNATIONAL for the Atomic Energy Commission at the National Reactor Testing Station in Idaho. This promising experiment will use an organic material—a carbon-hydrogen compound—in the dual role of moderator and coolant.

The diversified nuclear program at ATOMICS INTERNATIONAL includes:

1. Sodium Reactor Experiment. Located in Santa Susana Mountains, near Los Angeles. Fuel: either slightly enriched Uranium, or Thorium and U-233. Output: 20 Thermal Mw. Though experimental, the reactor will be equipped with heat exchanger and turbogenerator by Southern California Edison, who will feed 6.5 Mw of electric power to the surrounding area.

2. Full-scale Sodium Graphite Reactor Design. Fuel: same as above. Heat output: in the order of 250 Thermal Mw. Power Output: Uranium—75 Mw; Thorium—100 Mw; Thorium (after further development)—125 Mw. Capital costs, with full generating equipment, around $300 per Kw with Uranium, expected to be reduced with Thorium eventually to $200 per Kw. Power costs would thus decrease from 11.1 mills/kwh to 6.5 mills/kwh.

3. Water Boiler Research Reactor. Designed and built by ATOMICS INTERNATIONAL for use on Atomic Energy Commission research projects. Fuel: enriched Uranium. Power 5 watts. Flux: 10^{9}n/cm^2/sec (thermal). Experimental facilities include exposure holes, through-tube and vertical thermal column.

4. Livermore Research Reactor. For Atomic Energy Commission's laboratories at Livermore, Calif. A higher power version of the Water Boiler Research Reactor designed to operate at 500 W. These were the first two reactors in California.

5. Medical Research Reactor. Designed for a southern California university. Fuel: Uranyl sulphate, highly enriched with U-235. Power: 50 kilowatts. Thermal neutron Flux: 1.7 x 10^{12}cm^2/sec. Provision for gamma intensities to 1.3 reb/min per kw, fast neutron intensities of 4 reb/min per kw; also utilization of pure gamma activity of fission gases. Excellent exposure facilities for patient therapy and biological research. First reactor specifically designed for medical use.

6. Industrial Research Reactor for Armour Research Foundation of Illinois Institute of Technology, Chicago. Similar to 5 above, with experimental facilities for industrial applications. This reactor is now operating on a planned schedule that includes "time" for participating companies. This is the first reactor designed specifically for private industrial research.

7. General Research Reactor for Atomic Energy Research Institute, Japan. Similar to the Armour and Medical Research reactors described above. This will be the first nuclear reactor in the Far East, and is slated to be completed in 1957.

ATOMICS INTERNATIONAL has complete designs for reactors with a variety of fuel moderator and cooling systems for various applications, and offers a complete program of services in connection with all reactor projects, including:

- Advice on most suitable reactor type for a specific use
- Assistance in reactor site selection
- Aid in meeting AEC requirements
- Coordination of reactor plans with building plans
- Installation supervision
- Training of operating and maintenance personnel
- Assistance in fuel loading and initial reactor operation
- Design counsel in later modification or expansion
- Assistance in public information

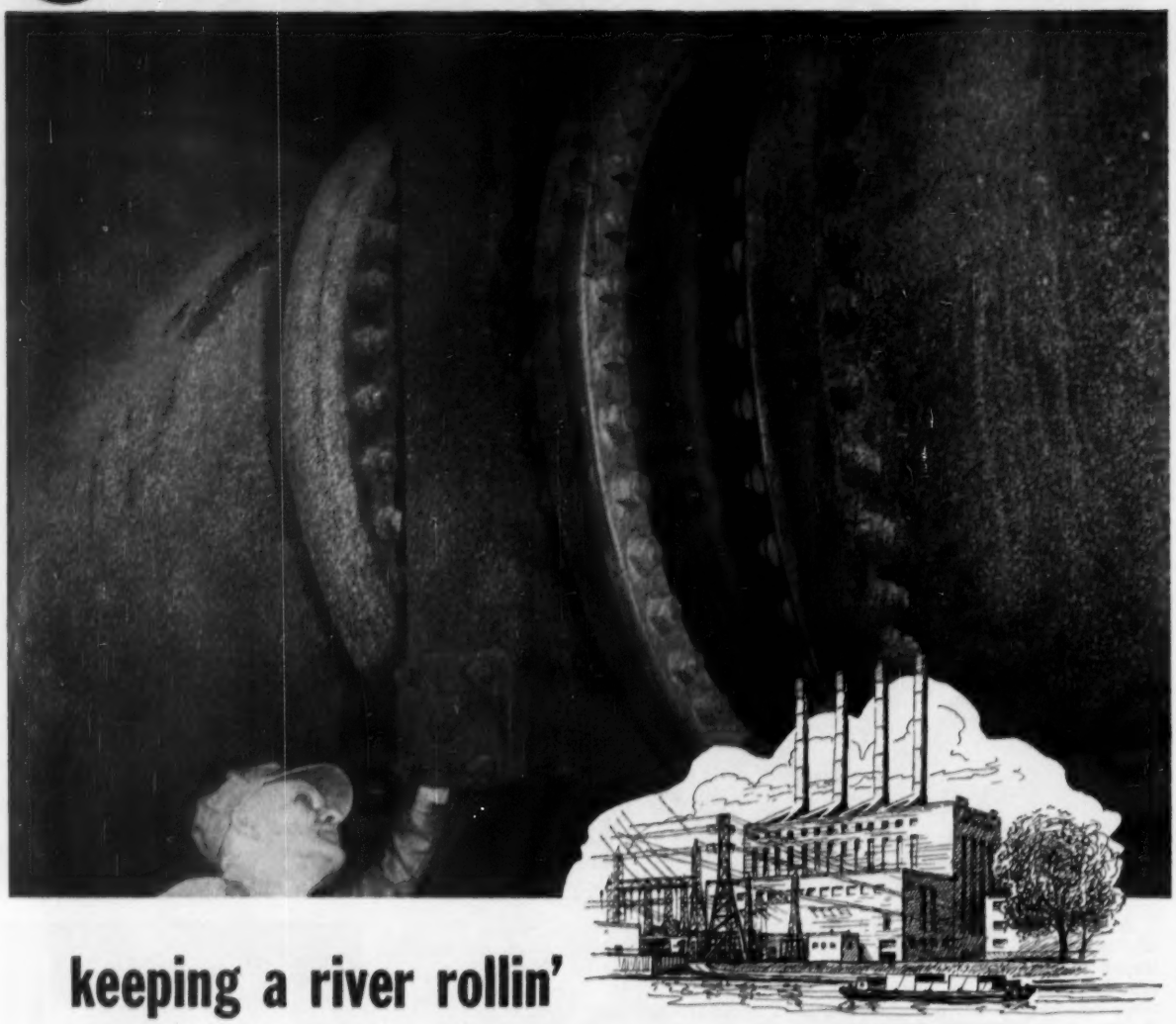
Dr. Marlin Remley of Atomics International activates Armour Reactor—first for private industry.

If you are interested in any phase of our activities, ATOMICS INTERNATIONAL is staffed and equipped to help you. Please write: Director of Technical Sales, Dept. PW-N5, ATOMICS INTERNATIONAL, P.O. Box 309, Canoga Park, California. Cable address: ATOMICS.

ATOMICS INTERNATIONAL
A DIVISION OF NORTH AMERICAN AVIATION, INC.
PIONEERS IN THE CREATIVE USE OF THE ATOM

US RUBBER

EXPANSION JOINTS



keeping a river rollin'
and the pipes from rockin'

A river of 390,000 gallons of water per minute rolls through the four surface condensers in Niagara Mohawk Power's plant at Oswego, New York. Here is generated enough power to heat 384,000 household steam irons every hour. Ravenous furnaces consume 3600 tons of coal every 24 hours at full load.

The piping in Niagara's condenser system can't rock or rattle itself to death despite the tremendous capacities and pressures encountered. U. S. Rubber Expansion Joints are the flexible connections that allow the pipes to give and take, to literally ride with the punch.

"These Expansion Joints were installed in 1940," says the plant superintendent, "and they've never given us trouble. We use them in sizes from as small as 6" all the way up to 48", and at water temperatures up to 170 degrees Fahrenheit. We know we will get many more years' wear out of them."

To absorb excess stresses due to expansion and contraction, to insulate against vibration, take care of misalignment, specify U. S. Expansion Joints. They are available at any of the 28 "U.S." District Sales Offices, or write us at Rockefeller Center, New York 20, N. Y.

US RUBBER

Mechanical Goods Division

United States Rubber

NEW DIMENSIONS IN COMBUSTION CONTROL

For the largest to the smallest power plants

Today's boiler plant is only as efficient as the instrumentation which operates it. In selecting the correct equipment to assure completely automatic operation, to provide cost reductions through labor saving, and greater efficiency, the companies shown on these pages have looked to Hays. The newest in power plant design coupled with Hays workmanship and follow-through have given them the results they sought.

SKILLED FACTORY ENGINEERING

Hays systems are engineered to your specific requirements by a staff of specialists with years of experience on hundreds of boiler plants from the smallest to the largest. The particular instrument and control "package" necessary to handle your conditions is selected from the Hays product line; panel design, complete wiring, conduit, piping and control system diagrams are closely checked to see that they fit your requirements.

NATIONWIDE SERVICE

Service on Hays products is available throughout the country. Trained service engineers, from the factory or from Hays representatives in principal cities, can provide "start up" calibration and adjustment as well as subsequent periodic preventive maintenance service on your equipment.

For best results you will want to confer with Hays Sales Engineers in the earliest stages of your planning.

Write for complete information. Bulletin 55-605-83.

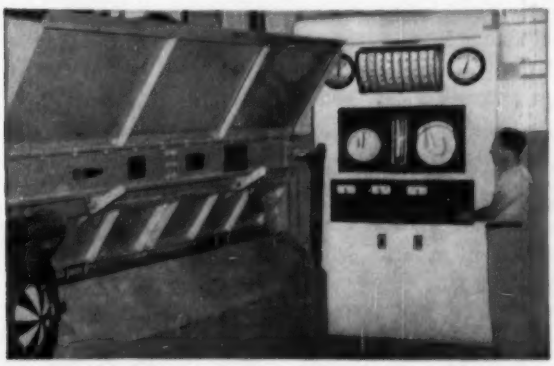
THE hays CORPORATION

MICHIGAN CITY, 3, INDIANA

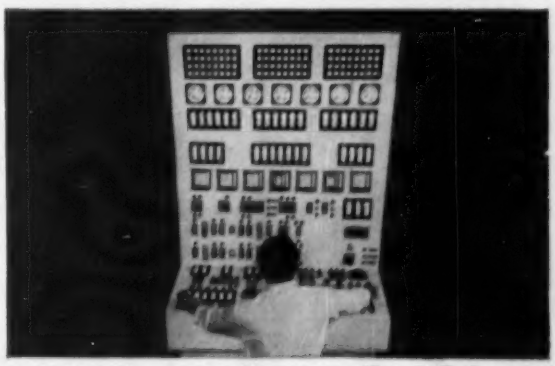
Automatic Combustion Control • Var-flow Meters and Ventrol • Electronic Oxygen Recorders • CO_2 Recorders Boiler Panels • Gas Analyzers • Combustion Test Sets Draft Gages • Electronic Flowmeters • Miniature Remote Indicators • Electronic Feed Water Controls

At Baldwin Locomotive Works, the Hays combustion control has aided substantially in saving 30,000 tons of coal per year and in reduction of maintenance. It is now possible to operate the power plant with 42 less men.

At Morton Salt Company, Manistee, Michigan, the fact that electricity doesn't freeze is vital in this semi-outdoor boiler which handles load swings up to 80,000 lb/hr at 85% efficiency with help of Hays electrically operated combustion control system.



At Falstaff Brewing Corporation, modernization and Hays metering type control have resulted in boiler efficiency of 82%, fuel cost reduction of several hundred dollars per month, CO_2 up from 6% to 12%, and maintenance costs lowered 65%.



At Louisiana Power and Light, a compact Hays B. T. G. control panel only 4 feet wide controls a giant 1,000,000 lb/hr boiler, turbine and generator! Instrumentation and control by Hays includes electronic mercuryless flow meters and other electronic instruments.

a new NICHOLSON STEAM TRAP

for capacities up to 800 lbs.

Model N-125 available through your local distributor, as well as your Nicholson representative.

Now you can have all of the operating advantages of Nicholson design simplicity and rugged construction in the new, competitively priced Model N-125 steam trap for lower capacity applications.

Like other traps in the Nicholson line . . . it combines a unique thermostatic bellows, large orifice, and fast, intermittent valve action to assure effective and economical discharge of condensate and air from steam lines and equipment.

The Model N-125 has a maximum discharge capacity of up to 800 lbs. of condensate per hour at pressures up to 125 lbs. It operates on a temperature differential of only a very few degrees. Its tight, positive shut-off avoids dribbling, leaking, wasting steam.

NICHOLSON

W. H. NICHOLSON and Company

TRAPS • VALVES • FLOATS • METAL PARTITIONS
LAUNDRY, DRY CLEANING AND PRESSING MACHINERY

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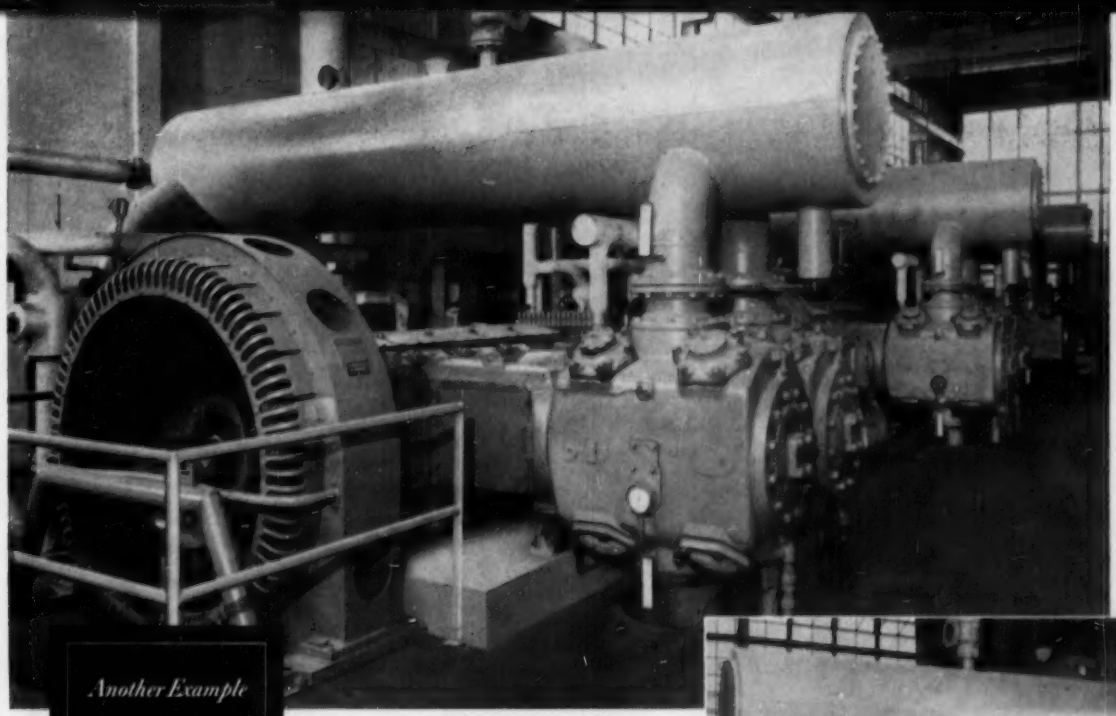
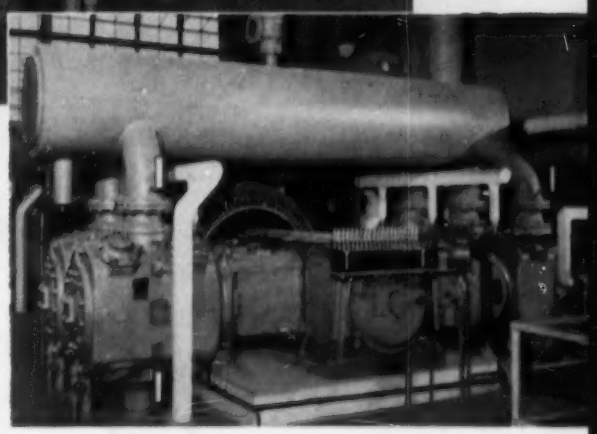


Another Example of Efficient Power at Lower Cost

At General Electric's Appliance Park Plant, three Cooper-Bessemer 1000 hp FM-5 air compressors play a part in supplying industrial air from a central location, for many and varied air services.



Close-up of one of the motor-driven Cooper-Bessemer units.

AIR...from Cooper-Bessemer Compressors for modern production at Appliance Park

• At General Electric's new Appliance Park Plant in Louisville, where these Cooper-Bessemer 1000 hp air compressors are at work, they've concentrated the manufacture of various appliance lines in this one giant plant. The object is highest efficiency in quality production at the lowest manufacturing cost.

The Cooper-Bessemer units, meeting all of the many and varied compressed air needs, fit in ideally with this policy of concentration, efficiency and minimum cost. Installed in a centrally located building, these modern two-stage, opposed balance compressors provide a dependable source of air, yet occupy minimum area. And, being well balanced, they require less foundation than was possible with older type machines.

If your plans call for compressed air on a long-term basis, find out about the extra advantages you'll get with Cooper-Bessemer. They range from 100 to 5,000 horsepower; save space, housing installation and piping costs . . . without sacrificing flexibility, ruggedness or accessibility.

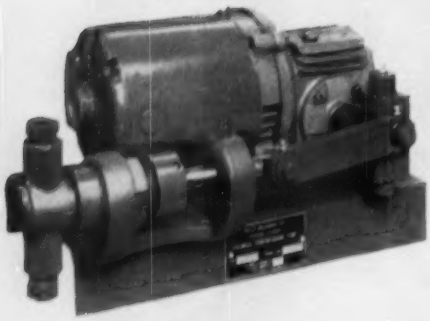
MOUNT VERNON, OHIO

COOPER-BESSEMER

GROVE CITY, PENNA.

New York City • Seattle, Wash. • Chicago, Ill. • Houston, Dallas, Greggton, Pampa and Odessa, Texas • Washington, D. C. Shreveport, La. • San Francisco, Los Angeles, Calif. • St. Louis, Mo. • Gloucester, Mass. • New Orleans, La. • Tulsa, Okla. Caracas, Venezuela • COOPER-BESSEMER OF CANADA, LTD., Edmonton and Calgary, Alberta, Canada.

DIESELS • GAS ENGINES • GAS-DIESELS • ENGINE-DRIVEN AND MOTOR-DRIVEN COMPRESSORS



Economical
LIQUID PROPORTIONING

for systems requiring limited capacities

Compact and simplified, the all-new Hills-McCanna model 4411 chemical metering pump brings a new standard in precision metering. Features typical of larger Hills-McCanna models are retained—now for the first time, saving features of smaller installations are offered.

A single or double feed, positive displacement, plunger type pump, the model 4411 provides continuous proportioning of chemicals for water conditioning, waste treatment, chemical additive feeding and similar applications. Ease of capacity adjustment and simplicity of maintenance are provided for in the simple stroke adjustment and "capsulated" construction of the reagent end.

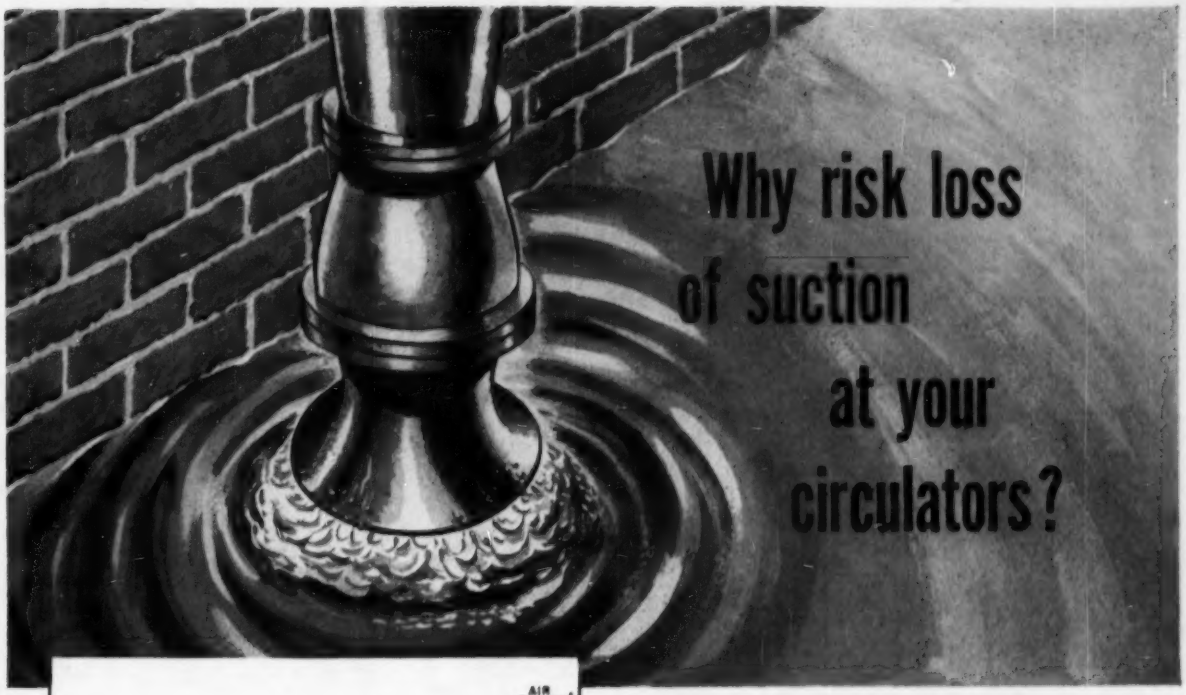
For new cost savings in liquid proportioning, consider the model 4411 and all its economical features. Contact Hills-McCanna today!

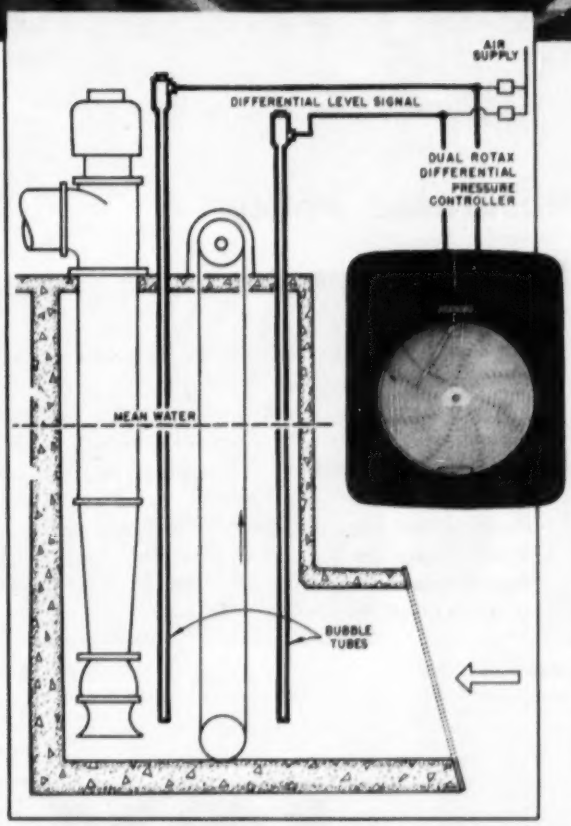
Off the shelf delivery . . . is yours with the model 4411.

WRITE TODAY *for full information on this remarkable new metering pump. Ask for Bulletin No. 601.*

HILLS-McCANNA COMPANY

2369 W. Nelson • Chicago 18, Illinois





Schematic diagram shows how water level differential across screen is continuously measured by bubble tubes. Rotax Controller starts and stops screen and spray motors as required.

. . . let Foxboro Control keep traveling screens clean — *automatically*

You can easily make certain that your suction well will never go dry due to a sudden pile-up of refuse on the traveling screen. Just put Foxboro Liquid Level Type Traveling Screen Control on guard.

This completely adjustable Foxboro System automatically starts the screen motor and cleansing spray whenever accumulated refuse causes water level on opposite sides of the screen to differ more than a desired, pre-set amount. And, in addition to purging the screen and restoring proper intake level, this versatile system can carry out any or all of the following "positive protection" functions — depending on plant requirements: 1. Annunciate "high" differential water level at adjustable set-points. 2. Prevent start of screen until sprays are on — to avoid carry-over. 3. Shut down screen motor and spray pump (a) when proper level is restored — or (b) when screen has made one complete rotation. 4. Indicate or record differential level in ranges from 0-5" water to 0-50" water. 5. Annunciate loss of purging air supply. 6. Provide centralization of *all* screen house functions.

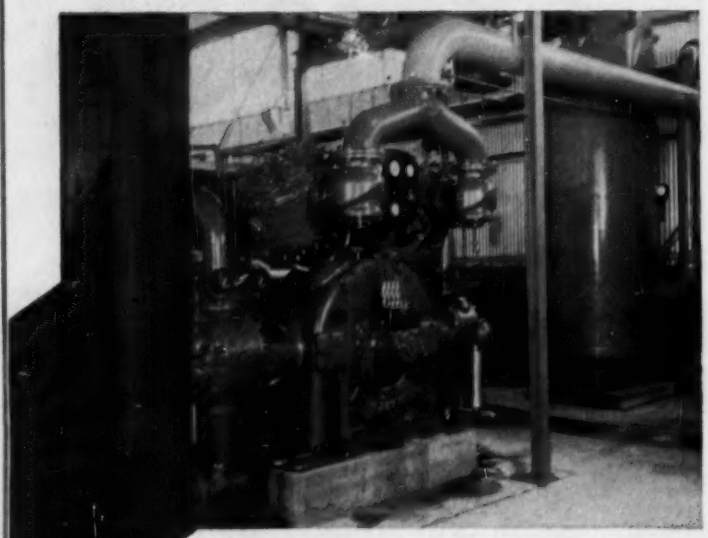
Let this modern system protect your plant against costly shut-downs. It's easily installed, inexpensive to operate, thoroughly dependable. For full details, contact your nearby Foxboro Field Engineer, or write **The Foxboro Company, 689 Neponset Ave., Foxboro, Mass.**

FOXBORO
REG. U.S. PAT. OFF.

INSTRUMENTATION
FOR THE POWER INDUSTRY

CYLINDER AND LINER

CROSSHEAD GUIDE



JOY WN-114 heavy-duty, two-stage, double-acting compressor. Capacity 1186 to 1948 CFM, 125 psi.

You get a free "Insurance Policy" with the JOY WN-114 Compressor

Joy's replaceable cylinder liners and crosshead guides are your "Insurance Policy" against down-time and lost production. They eliminate reboring . . . a replacement liner can be installed quickly and easily by your regular maintenance personnel. The liner itself is made of a special iron alloy, honed to a surface smoothness of four micro-inches.

Joy WN-114 compressors have full force-feed lubrication to all friction-bearing surfaces. The compact, semi-radial cylinder arrangement and exact crankshaft counterweighting give proper balance . . . eliminate vibration wear and tear. Joy "Dual Cushion" valves run quietly without valve shock . . . have extra large air passages to minimize air friction.

These features are built into every Joy heavy-duty compressor, whether for continuous service at standard plant pressures, high or low pressures, or vacuum pump applications. Be 'insured' against air power interruptions . . . for more information write ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pennsylvania.*** In Canada, *Joy Manufacturing Company, (Canada) Galt, Ontario.*

Send for free bulletin 126-16.

Consult a Joy Engineer

For Air and Gas Compressors, Oxygen and Nitrogen Generators, Vacuum Pumps and Boosters, Conveyors, Fans, Electrical Connectors, Hydraulic Fittings and Hose Assemblies.

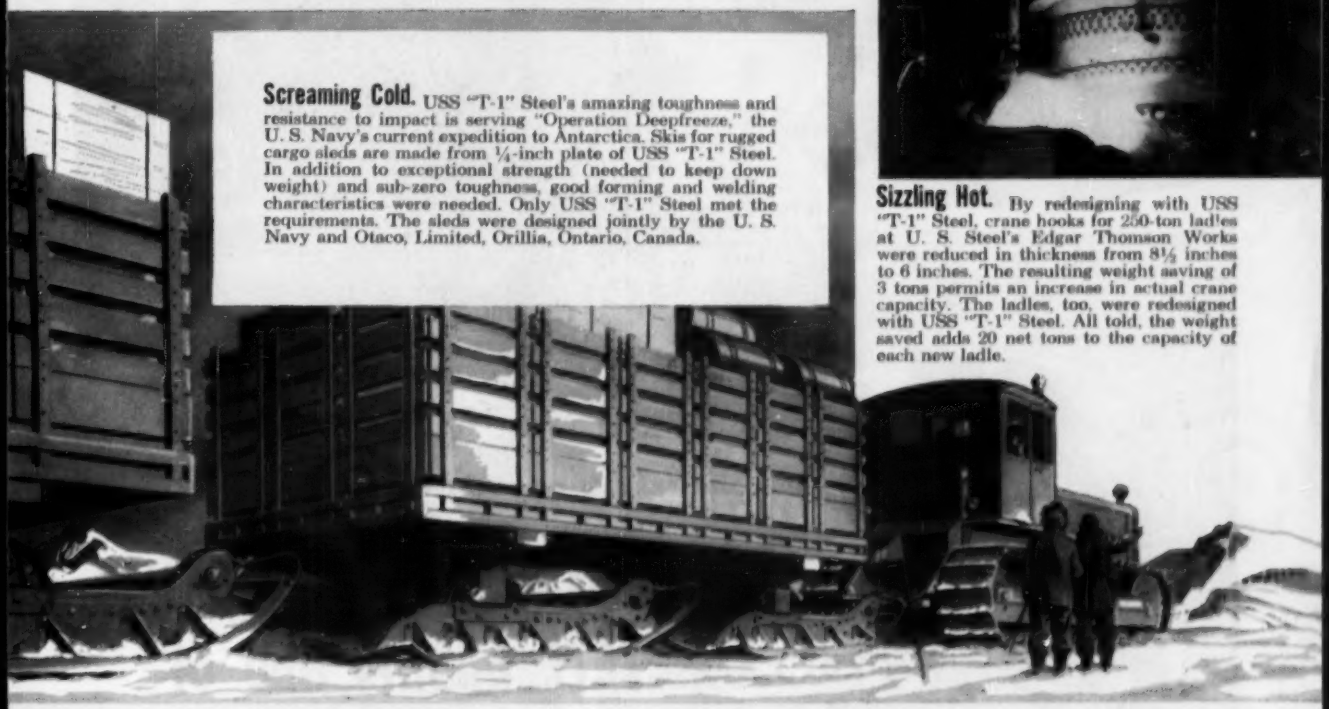
WBW-1 6701-126

JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885

HOW USS "T-1" STEEL IMPROVES THESE PRODUCTS:

Sizzling Hot. By redesigning with USS "T-1" Steel, crane hooks for 250-ton ladles at U. S. Steel's Edgar Thomson Works were reduced in thickness from 8½ inches to 6 inches. The resulting weight saving of 3 tons permits an increase in actual crane capacity. The ladles, too, were redesigned with USS "T-1" Steel. All told, the weight saved adds 20 net tons to the capacity of each new ladle.



Screaming Cold. USS "T-1" Steel's amazing toughness and resistance to impact is serving "Operation Deepfreeze," the U. S. Navy's current expedition to Antarctica. Skis for rugged cargo sleds are made from ¼-inch plate of USS "T-1" Steel. In addition to exceptional strength (needed to keep down weight) and sub-zero toughness, good forming and welding characteristics were needed. Only USS "T-1" Steel met the requirements. The sleds were designed jointly by the U. S. Navy and Otaco, Limited, Orillia, Ontario, Canada.

28 Million Pounds of wet, abrasive coal are handled each day at this steam-electric generating station. And USS "T-1" Steel is being used at points of severe wear in coal chutes and hoppers, pulverizer feed pipes and exhaust pipes, and for liners of ash collectors. USS "T-1" Steel's durability under impact and impact abrasion, its great tensile strength and its good weldability are often essential in rugged coal handling equipment. USS "T-1" Steel can add service life and cut repair and maintenance costs in many types of heavy-duty equipment.

Repair Reduces Downtime. In this coal stripping operation, time costs more than any other item; and *lost* time, caused by breakage and wear of power shovel parts, was costing far too much. So the owner, Putnam & Greene, Inc., Philipsburg, Pennsylvania, started using USS "T-1" Steel for repair work. As a result, size and weight of parts have been reduced, while durability has been improved substantially. What's more, USS "T-1" Steel's good weldability speeds repair work.

How It Can Help You

USS "T-1" Steel, with its high minimum yield strength of 90,000 psi and its minimum tensile strength of 105,000 psi, can help you design or build lighter-weight equipment that will last longer. Its unusual toughness can help you design or build equipment capable of taking heavy impact and abuse at sub-zero temperatures. Its excellent weldability can help you cut the cost of fabricating highly stressed parts, and to reduce repair and maintenance expense. Its good creep rupture strength can help you put more durability in equipment that operates at temperatures as high as 900 degrees F.

Somewhere in your operation, versatile USS "T-1" Steel can help you. Write, wire, or phone United States Steel, Room 5433, Pittsburgh 30, Pa.

UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
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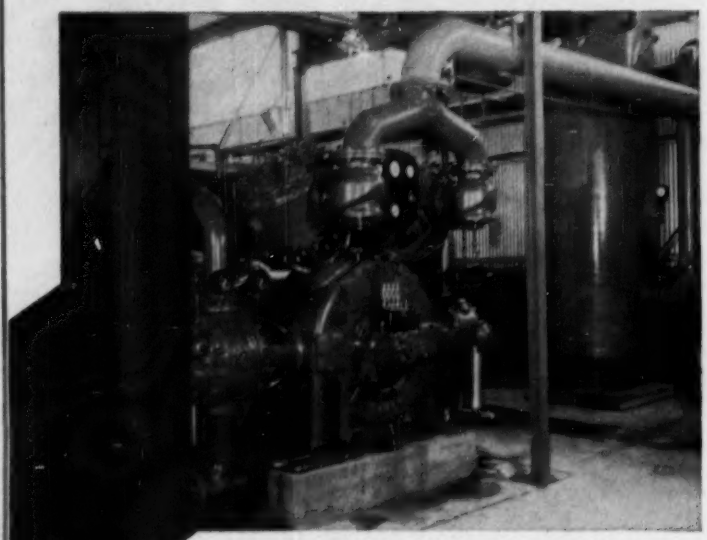
USS "T" CONSTRUCTIONAL ALLOY STEEL

USS

UNITED STATES STEEL

CYLINDER AND LINER

CROSSHEAD GUIDE



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JOY

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HOW USS "T-1" STEEL IMPROVES THESE PRODUCTS:

Sizzling Hot. By redesigning with USS "T-1" Steel, crane hooks for 250-ton ladles at U. S. Steel's Edgar Thomson Works were reduced in thickness from 8½ inches to 6 inches. The resulting weight saving of 3 tons permits an increase in actual crane capacity. The ladles, too, were redesigned with USS "T-1" Steel. All told, the weight saved adds 20 net tons to the capacity of each new ladle.

Screaming Cold. USS "T-1" Steel's amazing toughness and resistance to impact is serving "Operation Deepfreeze," the U. S. Navy's current expedition to Antarctica. Skis for rugged cargo sleds are made from ¼-inch plate of USS "T-1" Steel. In addition to exceptional strength (needed to keep down weight) and sub-zero toughness, good forming and welding characteristics were needed. Only USS "T-1" Steel met the requirements. The sleds were designed jointly by the U. S. Navy and Otaco, Limited, Orillia, Ontario, Canada.

28 Million Pounds of wet, abrasive coal are handled each day at this steam-electric generating station. And USS "T-1" Steel is being used at points of severe wear in coal chutes and hoppers, pulverizer feed pipes and exhaust pipes, and for liners of ash collectors. USS "T-1" Steel's durability under impact and impact abrasion, its great tensile strength and its good weldability are often essential in rugged coal handling equipment. USS "T-1" Steel can add service life and cut repair and maintenance costs in many types of heavy-duty equipment.

Repair Reduces Downtime. In this coal stripping operation, time costs more than any other item; and *lost* time, caused by breakage and wear of power shovel parts, was costing far too much. So the owner, Putnam & Greene, Inc., Philipsburg, Pennsylvania, started using USS "T-1" Steel for repair work. As a result, size and weight of parts have been reduced, while durability has been improved substantially. What's more, USS "T-1" Steel's good weldability speeds repair work.

How It Can Help You

USS "T-1" Steel, with its high minimum yield strength of 90,000 psi and its minimum tensile strength of 105,000 psi, can help you design or build lighter-weight equipment that will last longer. Its unusual toughness can help you design or build equipment capable of taking heavy impact and abuse at sub-zero temperatures. Its excellent weldability can help you cut the cost of fabricating highly stressed parts, and to reduce repair and maintenance expense. Its good creep rupture strength can help you put more durability in equipment that operates at temperatures as high as 900 degrees F.

Somewhere in your operation, versatile USS "T-1" Steel can help you. Write, wire, or phone United States Steel, Room 5433, Pittsburgh 30, Pa.

UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST • UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS "T1" CONSTRUCTIONAL ALLOY STEEL

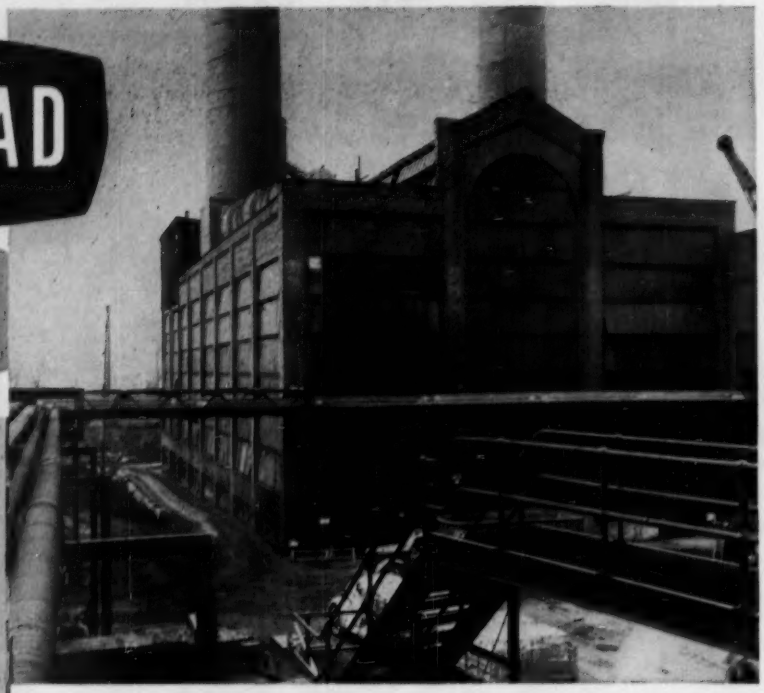
USS

UNITED STATES STEEL

OVERHEAD

OR

underground



Ric-wiL offers the COMPLETE quality line of prefabricated piping systems

Ric-wiL factory prefabricated piping systems, *timed* to your schedule and *shipped* directly to the job site, can save you valuable time and money. Insulated units are available for steam, hot water, oil, other viscous fluids, process liquids and refrigeration lines . . . and remember . . . Ric-wiL is the quality system of exceptionally high mechanical strength and thermal efficiency.

Quality Piping Systems . . .
. . . of Exceptionally High Thermal Efficiency

RIC-WIL

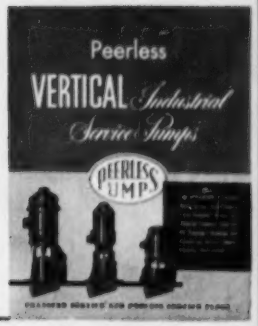
PREFABRICATED INSULATED PIPING SYSTEMS

BARBERTON, OHIO

IN CANADA: THE RIC-WIL COMPANY OF CANADA LIMITED

Write for a copy of the new Ric-wiL Catalog . . .

look AT THE PUMPING PROBLEM *two ways*



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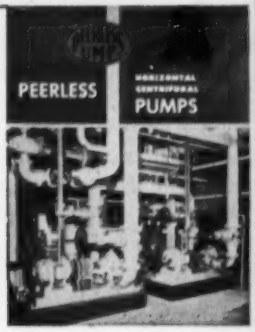

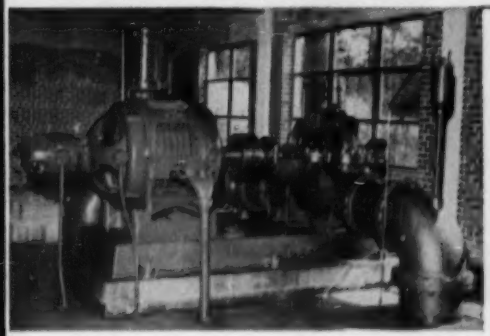

PEERLESS PUMP DESIGNS PROVIDE THE RIGHT TYPE FOR DOING THE JOB BETTER

You pick the design; Peerless will supply the pump. From one of the broadest range of pump capacities, heads, horsepowers, you can choose a Peerless horizontal or a Peerless vertical pump for almost every liquid transfer job, involving either water or process liquids.

In the picture at the top above, a concentrated solution of sulphuric acid and aluminum sulfate is being pumped by Peerless vertical industrial service pumps. To find out all about them request Peerless Bulletin No. B-505.

The Peerless horizontal type A pump shown just above, is one of three that supplies plant water for a textile mill. To find out all about them request Peerless Bulletin B-1300 and B-1350.

Use the coupon below to find how these Peerless designs can meet all your pumping needs with economy, efficiency and dependability.

PEERLESS PUMPS

fmc

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Factories: Los Angeles 31, Calif., and Indianapolis 8, Ind.
Offices: New York; Atlanta; Chicago; St. Louis; Indianapolis, Ind.; Phoenix; Fresno; Los Angeles; Plainview and Lubbock, Texas; Albuquerque, New Mexico.
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PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
301 West Avenue 26, Los Angeles 31, California

Please send bulletins checked below:

- ☐ PEERLESS INDUSTRIAL SERVICE PUMPS (B-505)
- ☐ PEERLESS TYPE A HORIZONTAL PUMPS (B-1300)
- ☐ AND TYPE AS (B-1350)

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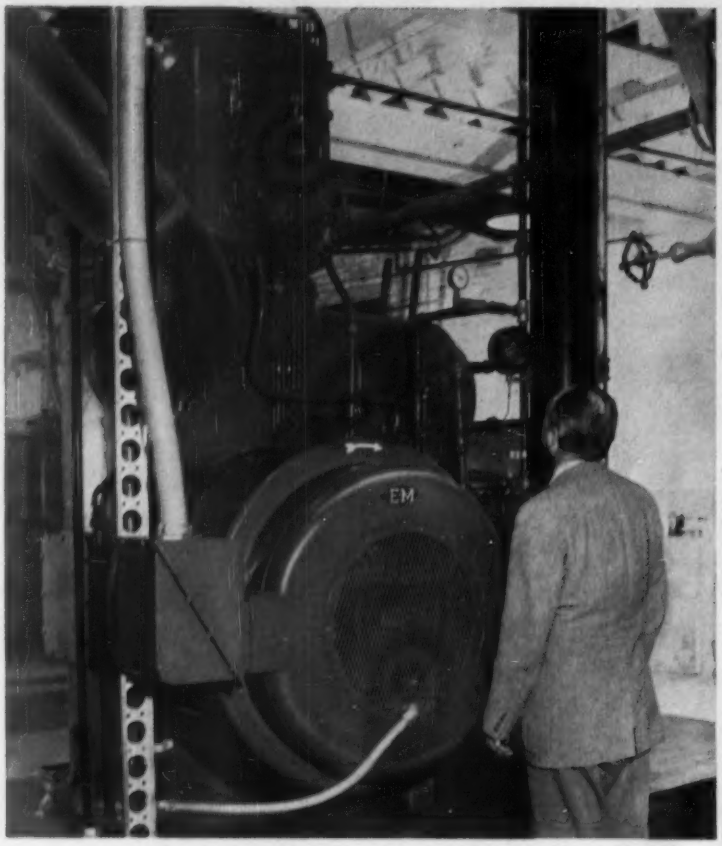
POW

What control would you specify for a flange-mounted synchronous motor air compressor drive?



Paktrol efficiently controls this E-M 200 hp, 514 rpm, 1.0 PF, 440-volt Flange-Mounted Synchronous Motor at The Eberhard Company.

Here's why Eberhard chose the NEW E-M PAKTROL CONTROL

The Eberhard Company of Cleveland, Ohio, a division of Eastern Malleable Iron Company, selected an E-M Flange-Mounted Unity Power Factor Synchronous Motor to drive an air compressor in their plant. The compressor is unloaded at start and operates at standard load and speed.

Such characteristics meant that a simplified control could be used. A control having meters, field rheostat and a separate motor-generator set for field excitation was unnecessary.

Careful comparison by Eberhard of the new simplified E-M Paktrol Control with other type controls resulted in it being chosen for the features given below.

Features and Advantages of NEW PAKTROL CONTROL

1 Lower Cost — Wherever Paktrol can be used costs are saved two ways. Its built-in selenium rectifier lowers both initial and installation costs as compared to those of a separate synchronous motor control and motor-generator set.

2 Simple Operation — Start-stop pushbutton magnetic full-voltage operation with "conscious" control by the E-M developed Polarized Field Frequency Relay system.

3 Full Protection for Motor and Control — Relays protect against overloads, overcurrents, abnormally low line voltage, single-phase operation, or out-of-step operation. Fuses protect rectifier and transformer.

4 Minimum Maintenance — Static rectifier for d-c field excitation eliminates maintenance of brushes, commutator, and bearings of conventional rotating exciter.

Paktrol is available for use with unity power factor flange-mounted synchronous motors driving air compressors in ratings of approximately 75 thru 200 hp in applicable speeds of 720, 600, or 514 rpm.

Let your nearest E-M sales engineer show you how to get the best performance from your air compressor flange-mounted synchronous motor drive. Write the factory for E-M Paktrol Control Bulletin No. 220.

E-M

3100—TPA—2184

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

***Specialists in making motors do* EXACTLY WHAT YOU WANT THEM TO**

Fact:

STURDY WESTINGHOUSE-STURTEVANT INLET SPIN CONTROL SAVES FAN POWER WITH CONSTANT-SPEED MOTORS

Operating mechanism is shielded from the gas stream but is readily accessible from the outside for inspection and maintenance.

5-POINT POSITIVE OPERATION. As link and lever (1) moves the operating ring (2) hardened steel spherical pins (3) turn crank arms (4) welded to the tubular vane cores (5). Each vane turns on a heavy steel rod anchored between the center mechanism and outer steel support. No lubrication is required.

SPIN CONTROL CUTS OPERATING COST

The combination of Westinghouse Inlet Spin Control and the simple squirrel cage constant speed motor is less costly to install and provides greater overall power savings than other types of mechanical draft control.

SMOOTH, SIMPLE ACTION

Inlet Spin Control has no gears—no backlash. Provides instantaneous control of draft. Vanes move rapidly in the open range, yet fine adjustment is possible in the near-closed position. Extremes of heat and cold do not affect its operation in any way.

MOST EFFICIENT, MOST ECONOMICAL

In any comparison of both forced and induced draft fans and their control devices, you will find Inlet Spin Control is both the most efficient and economical choice.

MORE FACTS?

Call your nearest Westinghouse-Sturtevant Sales Engineer . . . he's the "Man with the Facts". . . or fill in the coupon below.

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Hyde Park, Boston 36, Mass.

Please send more facts on Inlet Spin Control.

NAME AND TITLE.....

COMPANY.....

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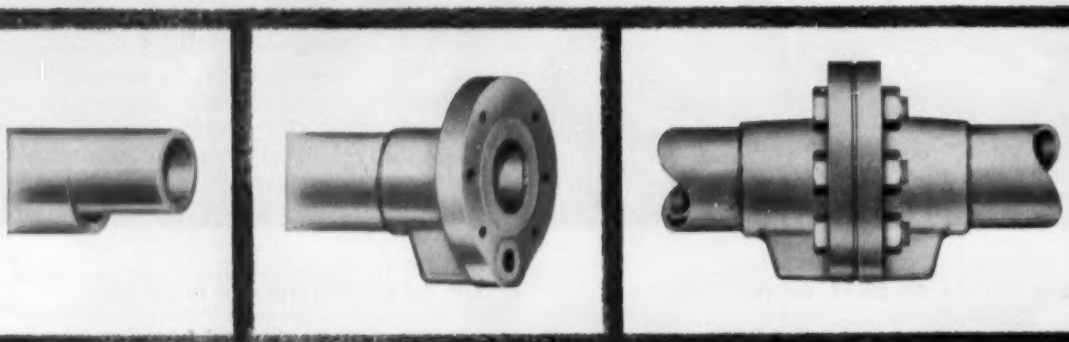
Completing the new concept in steam-traced pipe . . .

NEW ALCOA FLANGE

Makes joining UNITRACE sections as simple as 1, 2, 3

ALCOA created UNITRACE®, a new concept in steam-traced pipe . . . steam and product passages extruded in a single unit of corrosion-resistant ALCOA® Aluminum. The new UNITRACE flange, cast in ALCOA Aluminum alloy A356-T6, adds simple, efficient joining to that concept. Both steam and product passages are cast as integral parts of the flange, thereby eliminating product "freezing" at the joints.

With UNITRACE and the new UNITRACE flange, you can save up to 30% on labor while cutting material and insulation costs. Get the full story today! Write for new illustrated booklet, *Alcoa Unitrace*. Address: Aluminum Company of America, 888-J Alcoa Building, Pittsburgh 19, Pennsylvania.



With this new Alcoa flange, three simple steps create efficient UNITRACE joints: (1) Cut back trace lines 1¾" from the ends of sections to be joined, (2) Slip flanges into place and weld their front faces and necks to the sections with 4043 weld wire, and (3) Bolt flanges together.

Two separate gaskets seal product and steam passages between mating flanges. Bolt holes mate with standard 150-pound, 2-inch ASA pipe flanges and fittings for easy joining to other piping and equipment.

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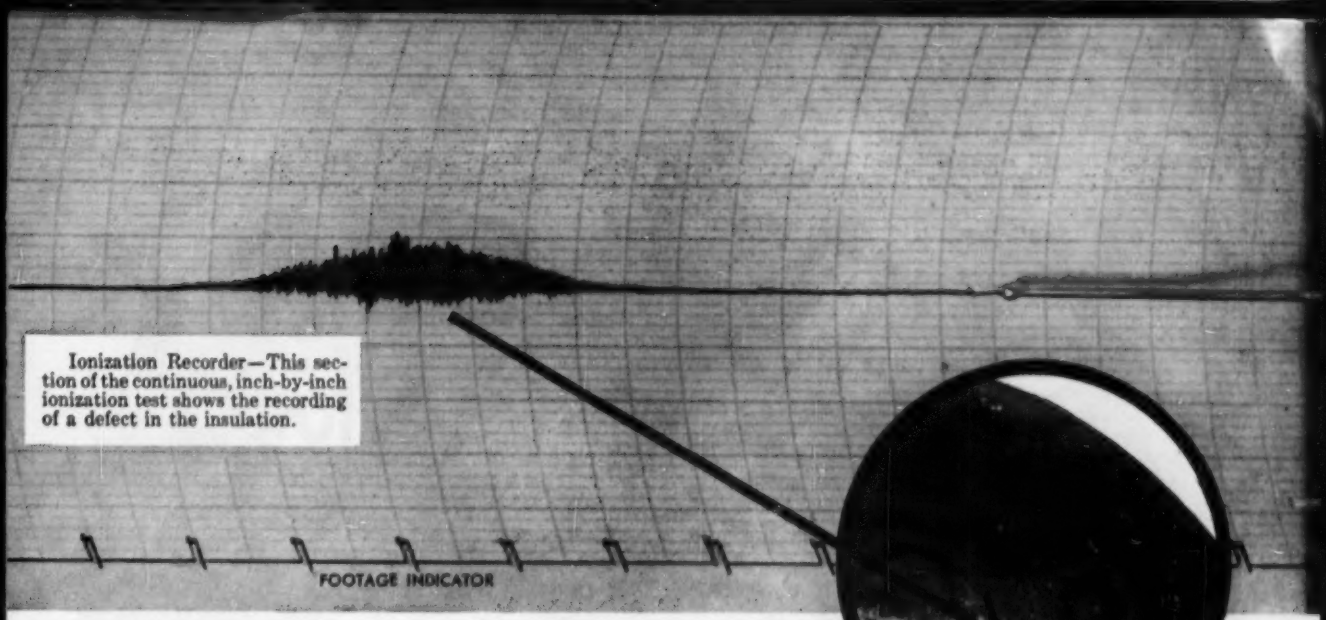

Ionization Recorder—This section of the continuous, inch-by-inch ionization test shows the recording of a defect in the insulation.

This void was detected by the "Gooding Test Train" ionization test. It was *not* detected by any of the industry's standard test procedures.

New Testing Procedure developed by Okonite

"Gooding Test Train" detects flaws in insulated power cable (2 kv and over) heretofore unrevealed by standard tests

The "Gooding Test Train" has significant value to cable users. This new system of *non-destructive* testing, developed and used only by Okonite, reveals imperfections which are frequently not detected by ordinary testing procedures. Some of them even slip by Okonite's super-voltage a-c and d-c tests (highest used in the industry) and "full reel" corona tests.

The "Gooding Test Train" consists of a series of three test sets. The entire length of cable passes consecutively through each set as follows:

SCHEMATIC DRAWING OF GOODING TEST TRAIN

1. Uniformity Test—A uniformity gauge continuously checks insulation thickness—locating any thin spots which might cause premature failure.

2. Ionization Test—This is the most important unit of the "Gooding Test Train". It can measure the corona level at any spot along the cable. Procedure is to test the cable *inch-by-inch* at a predetermined voltage which is sufficient to assure the user that the corona level is at least 1½ times the rated voltage. Voids and imperfections as small as a grain of sand have thus been identified and removed.

3. X-Ray Test—X-ray inspection of the cable is performed by a 250,000 volt X-ray machine. This determines the nature and extent of any of the flaws indicated above.

By such intensive testing, it is possible to eliminate previously unidentified imperfections that might otherwise lead to premature failure. Studies of such defects also help to identify the cause and permit preventive measures. The "Gooding Test Train" is now being used to test all Okonite's rubber-insulated cables rated at more than 2000 volts. It is a long step towards securing the "perfect cable" and, as such, of tremendous benefit to cable users.

For detailed information about Okonite's G.T.T. write for new Bulletin PW-1100A, to The Okonite Company, Passaic, N. J.

3804

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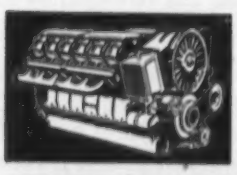
began in 1948 to build air-cooled DEUTZ diesel engines in large series. 7 years after, in 1955, the oldest engine manufacturers in the world had built and sold 150,000 air-cooled DEUTZ diesel engines totalling 7.5 Million B.H.P. These equipment engines are used all over the world for every kind of application. DEUTZ builds air-cooled 1 to 12-cylinder diesel engines with an output range from 5 to 250 B.H.P. for road vehicles, rail vehicles water craft, working machines in all fields of application, generator sets for stationary and mobile electric and power plants.



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Address inquiries from U.S.A., Alaska, Hawaii and Puerto Rico to:

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Users of packing know the talent of Teflon* in equipment handling corrosive chemicals or solvents at temperatures to 500 F. . . . Manufacturers of Teflon impregnated asbestos packings know it too—but they also know they have a tiger by the tail when it comes to combining asbestos and Teflon successfully. Until now the addition of fillers has been the way to get softness and resiliency, but fillers reduce chemical resistance.

PALMETTO TEFLON PACKING has no filler—no additives! A new and exclusive Palmetto process eliminates the need for foreign substances. Only pure Teflon and pure asbestos are used. The unique Palmetto process makes Teflon behave to give you a soft, resilient packing that seals with less gland pressure. For the most from Teflon in a packing specify Palmetto 1335 for acids, Palmetto 1350 for solvents and alkalis.

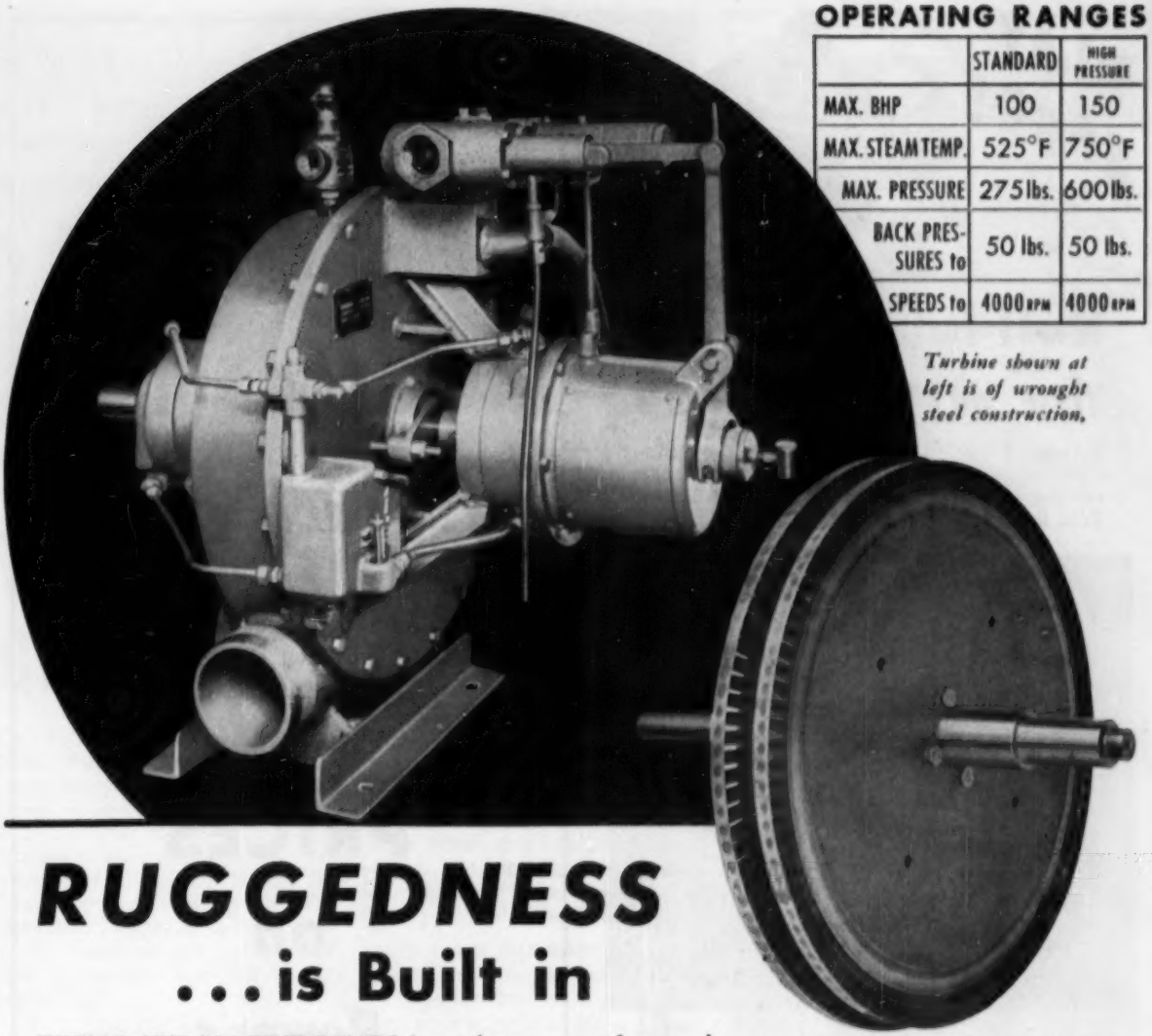
Palmetto Packings are known the world over for high quality and excellent service. No matter what the application, there is a Palmetto Packing that can serve you better. Contact us—or your nearest distributor listed on our insert at the head of the Packing section in Thomas Register.

**DuPont's polytetrafluoroethylene*

packing more performance into every application

PALMETTO Packings

GREENE, TWEED & CO.
NORTH WALES • PENNSYLVANIA



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MAX. BHP	100	150
MAX. STEAM TEMP.	525°F	750°F
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BACK PRESSURES to	50 lbs.	50 lbs.
SPEEDS to	4000 RPM	4000 RPM

Turbine shown at left is of wrought steel construction.

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WING STEAM TURBINES have been manufactured by L. J. Wing Mfg. Co. for nearly half-a-century. During that time these sturdy, dependable prime movers have been giving excellent service in thousands of industrial and marine installations under the most exacting conditions of operation. They are ideal for operating compressors, generators, fans, mixers and many other types of equipment. Reliability is inherent. Use the coupon to get further details.

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Please send copy of Auxiliary Turbine Bulletin T-54

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Roll tubes the WILSON Way

Rolling tubes in high pressure boilers, superheaters, economizers, marine steam generators and other heat exchange equipment is simple *and* safe with Wilson Tube Expanders.

Wilson Tube Expanders offer smooth, efficient rolling action, which insures firm seating of the tube, provides perfectly rolled joints, reduces time-wasting re-rolling and re-inspection. For example, Wilson Model 38 Tube Expander, shown here, is a popular tool which rolls and flares in a single operation. It is available for tubes from 1" OD to 4½" OD with various roll lengths for tube sheets ½" and up in thickness.

FREE Wilson Catalogs

Write for new Wilson Tube Cleaner Catalog 77 and comprehensive Tube Expander Catalog. ➡

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ONLY 5 MEN *(unskilled) were needed to do the job: two in the trench and 3 above.*

Western Carolina College Chooses GILSULATE® for New Steam Installation

On its modern campus at Cullowhee, N. C., Western Carolina College recently poured 66 tons of type B and 8 tons of type A GILSULATE on a 1500-foot steam line installation. This brought to more than 1200 tons the volume of GILSULATE used by North Carolina institutions, schools and colleges during 1955—enough to fill 40 railroad cars, or a ditch one yard wide by one yard deep and 10 city blocks long!

The installation consists of a 6" steam and a 2" condensate piping system. During pouring, only 2 men were required in the trench and 3 men above to open the bags and pour.

No other insulation for hot underground pipes can match this low-cost performance—just as no other insulation can match GILSULATE for *permanent* protection of piping systems. No wonder more and more engineers, architects and contractors are *specifying* GILSULATE for their hot underground piping work!

Whatever the type of job you have in mind—airport, school, utility, institution, factory, railroad—it will pay you to investigate the unusual features of this easily-installed, dependable, low-cost system. Use the coupon below or see your local GILSULATE dealer.

FACTS ABOUT GILSULATE

1. *EASY TO USE*—just pour and tamp ...pipe heat does the rest.
2. *FORMS 3 ZONES* of protection against heat loss and all hazards commonly encountered by hot buried pipes.
3. *NEEDS NO HOUSING OR MECHANICAL SHEATHS:* no mixing, special handling or equipment.
4. *ONLY NEEDS NORMAL PIPE SPACING:* for multiple pipe or cramped conditions.
5. *THREE TYPES AVAILABLE:*
   Type A for 220°-300° F. temp. range
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UNGRADED DITCH. *Concrete pads were located at 10-foot intervals and 4" transite pipe supports placed on top of them.*

THE TRIPLE-ZONE INSULATION SYSTEM FOR LIFE-TIME PROTECTION OF HOT UNDERGROUND PIPES

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SPECIAL FINNED EVAPORATORS & CONDENSERS
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Increase turbulence of air flowing over a surface and more heat is transferred from the surface. Develop a patterned surface to build turbulence to a maximum *within the allowable pressure drop limits*—and you have the principle of Halstead & Mitchell's latest contribution—exclusive "TURBU-FLO" finned surface!

"TURBU-FLO" assures you of extra-safe capacity ratings, for the added heat transfer it provides means an unusual margin of *added* capacity.

"TURBU-FLO" finned surface is immediately available to meet your every need. Describe your needs—and ask for Bulletin DE-200.

Halstead & Mitchell, Bessemer Building, Pittsburgh 22, Pa.

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the spiral conveyor of dependable service. Used on incline or horizontally.

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EXPOSED END IN BIN OR PILE

Mechanically handles materials from grain size to lump . . . sand, rice, seed, pellets, flakes, steel chips, wood waste, coal, etc.

STEEL TUBE OR CAST IRON TROUGH

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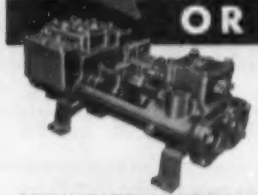

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F135

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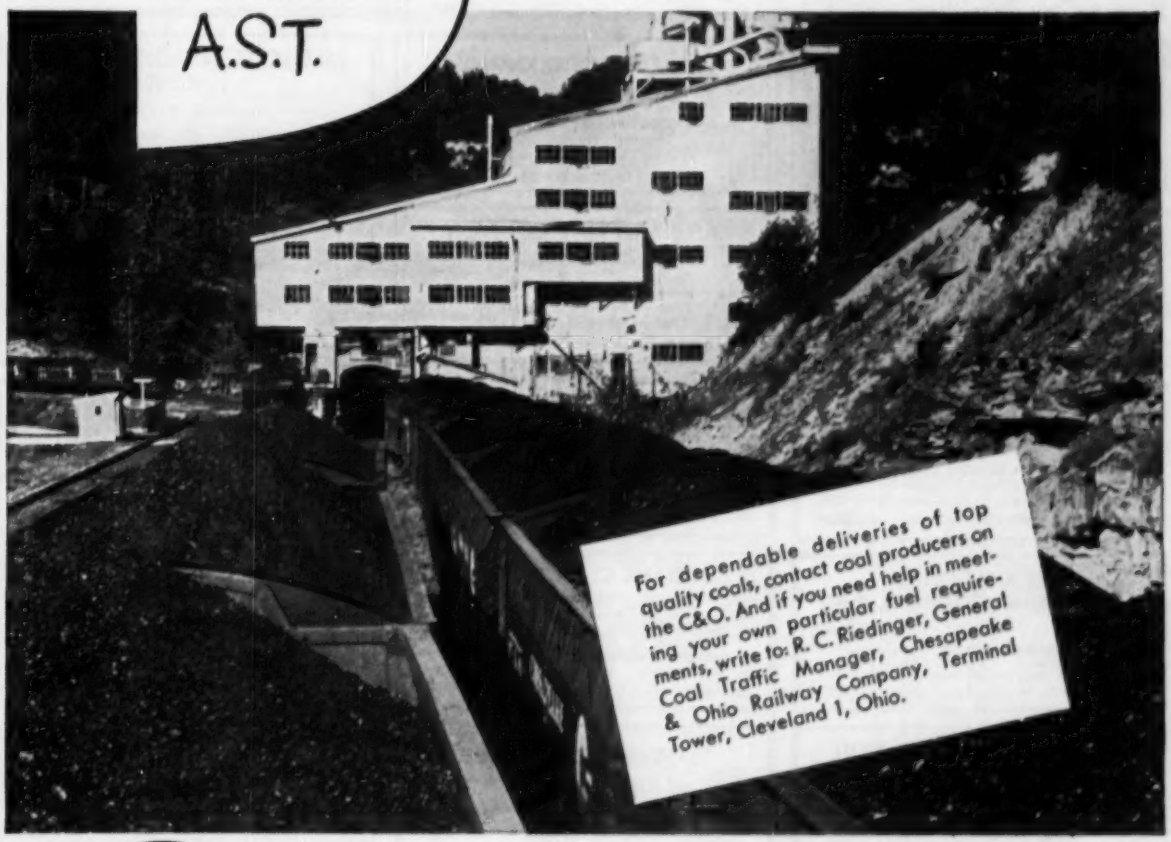
For dependable deliveries of top quality coals, contact coal producers on the C&O. And if you need help in meeting your own particular fuel requirements, write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake & Ohio Railway Company, Terminal Tower, Cleveland 1, Ohio.

Chesapeake and Ohio Railway

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Engineers and Constructors
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Engineers—Architects—Consultants
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Surveys, Reports, design and construction supervision of air conditioning, heating, ventilating, oil and gas burners & control systems.
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THE KULJIAN CORPORATION
Engineers - Constructors - Consultants
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(Steam, Hydro, Diesel)
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1200 N. Broad St. Philadelphia 21, Pa.

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THE J. G. WHITE ENGINEERING CORPORATION
Design-Construction-Reports-Appraisals
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EMPLOYMENT OPPORTUNITIES

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

Positions Vacant
Positions Wanted
Part Time Work

Civil Service Opportunities
Selling Opportunities Wanted
Selling Opportunities Offered

Employment Agencies
Employment Services
Labor Bureaus

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Send NEW ADS or Inquiries to Classified Adv .Div. of POWER, P. O. Box 12, New York 36, N. Y. for September issue closing August 10th

APPLICATION ENGINEERS

28-45, mechanical graduate or equivalent experience in combustion, design, operation, sales or development of heating or power plant, stokers, burners, or coalhandling equipment. Will manage engineering service and promotion in one of these territories: Indiana, Illinois, W. Pa., or all of New England. Unusual opportunity in a new department. Starting salary: $7,000 to $10,000 depending on experience. Company will pay moving expenses. Send complete resume of qualifications and experience to:

Classified Advertising Division
P-2726, POWER
P.O. Box 12 New York 36, N. Y.

REPLIES (Box No.): Address to office nearest you c/o this publication, Classified Adv. Div.
NEW YORK: P.O. Box 12 (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

System Dispatcher excellent opportunity for man with experience on high voltage transmission network. Location in Midwest. Reply P-2431, Power, giving qualifications and expected salary.

Maintenance Supervisor—age 30-65. Large midwest hospital. Supervise all aspects of building maintenance and assist in the planning of new construction. Write giving complete personal background and salary requirements. P-2614, Power.

SELLING OPPORTUNITY OFFERED

Manufacturer of surface condensers, feedwater heaters, oil heaters & coolers and pressure vessels, located in New Jersey, requires additional sales representatives. Contacts in Power and Industrial Plants desirable. RW-1953, Power.

POSITIONS WANTED

Chief Engineer, age 35, technical education, 11 years experience in all phases of operation and maintenance of steam electric power plants. PW-2351, Power.

Plant or Utility Engineer: B.S. Industrial Chem. 1941, Registered Professional Engineer. Experienced in plant and project engineering; also construction. Thoroughly familiar with piping, combustion, water treatment, economic studies, heat balances, selection and evaluation of plant equipment. PW-2561, Power.

SELLING OPPORTUNITIES WANTED

Manufacturers' Representative covering power and industrial firms in Eastern Pennsylvania, Southern New Jersey and Delaware desires additional lines. RA-2621, Power.

Established sales representative (three men), metropolitan New York City area desires additional line, preferably for industrial and, or, utility boilers. RA-2590, Power.

ADDITIONAL EMPLOYMENT ADVERTISING on pages 276 & 277

ATOMIC OPERATING ENGINEER

To supervise operation of Nuclear power plant and assist in training service personnel.

Power plant experience and some knowledge of pumps, turbines, generators and switch gear, and condensers required.

Chemical, Civil, Electrical or Mechanical Engineering degree desired.

If interested please send detailed resume and salary requirements to:

G. Y. TAYLOR, *Manager*
Employee Services Dept.
ALCO Products, Inc.
Schenectady, New York

All replies kept confidential

SR. ELECTRICAL ENGINEER

Foreign Employment

For responsible staff position which involves planning and staff engineering of new electrical power generation plants utilizing steam or gas combustion turbines and related facilities for major oil installation in Saudi Arabia.

Must be a graduate electrical engineer with proven supervisory ability with minimum ten years' experience in planning, design and study of utilities systems, power generation, transmission, distribution and related work. Minimum salary $1000 monthly plus allowances and generous benefits.

Write outlining personal history and work experience. Please include telephone number.

Recruiting Supervisor, Box 181

ARABIAN AMERICAN OIL COMPANY
505 PARK AVENUE
NEW YORK 22, NEW YORK

DESIGNERS PROCESS PIPING PRESSURE VESSELS

An established firm engaged in designing and building complete plants and equipment for the interesting and fast-growing chemical industry has several permanent openings for men with ASME code experience. We are particularly interested in men who would enjoy broad-range assignments and important personal responsibility with distinct opportunities for individual recognition. These are good jobs for the right men with sound company benefits and modern air-conditioned offices in downtown Cincinnati. Write or call.

VULCAN-CINCINNATI, Inc.
120 Sycamore St., Cincinnati 2, Ohio
DUnbar 1-1400

PROJECT ENGINEERS

Large engineering and construction firm has permanent staff positions open for graduate mechanical engineers with 3 years minimum experience as Project Engineer in design of steam electric power plants. Salary will be commensurate with experience and ability. Excellent working conditions.

Please give full details—including personal data, education, experience and salary desired in your reply.

Write or call collect, to:

THE KULJIAN CORPORATION
1200 N. Broad St., Phila. 21, Pa.
STevenson 2-9000

MECHANICAL ENGINEERS

With 2 to 10 years experience in central station power design. Permanent position with fine opportunity for advancement. Comprehensive fringe benefits. Write stating education, experience and salary desired.

DUKE POWER COMPANY
Employment Office, P.O. Box 2178, Charlotte, N.C.

MAINTENANCE SUPERVISOR

Age 30-65. Large midwest hospital. Supervise all aspects of building maintenance and assist in the planning of new construction. Write giving complete personal background and salary requirements.

P2506 POWER
520 N. Michigan Ave., Chicago 11, Ill.

engineers

Leeds & Northrup Co.

Has Attractive Offers Available For—

ELECTRICAL ENGINEERS

. . . with B.S. degree and at least 5 years' experience in Electrical power Controls and Operations.

MECHANICAL ENGINEERS

. . . with B.S. degree and at least 5 years' experience in Steam Power Plant Controls and Operation.

For over 50 years, Leeds & Northrup Company has been the world's foremost manufacturer of power plant controls.

If you would like to work in our Application Engineering Department with responsibility for engineering proven components into control systems for solving new problems in the power field, then communicate with us soon.

These positions will require 25% of your time spent on field tests and problems analysis in the power industry. The remaining time will be spent in Philadelphia. These are permanent positions.

THE SALARY IS OPEN AND THERE IS OPPORTUNITY FOR ADVANCEMENT

Write For Details To—

Technical Employment Division

LEEDS & NORTHRUP COMPANY

4901 Stenton Avenue Philadelphia 44, Pa.

MECHANICAL ENGINEER

Exceptional chance for rapid advancement for a man not over 45 years old with experience in design of steam turbines or similar centrifugal machinery in design department of well established, nationally known, central New England manufacturing company. Pension plan and other benefits. Write giving experience, qualifications, references and personal data. Address

P-2192, POWER
Classified Advertising Division
P.O. Box 12, New York 36, N. Y.

TURBINE DESIGNER

Graduate Mechanical Engineer or equivalent. Minimum 5 years experience all phases of high pressure, high speed auxiliary Steam Turbine Design.

ALSO

JUNIOR TURBINE DESIGNERS

Please send resume of experience, personal history and salary desired. All replies confidential. Write to:

THE WHITON MACHINE CO.
NEW LONDON, CONN.

Electrical Engineers Designers

BECHTEL

Offers you immediate long range engineering opportunity in

San Francisco or Los Angeles, Calif.

Engineers, designers and draftsmen required with the following experience:

Electrical Sub-Station
Hydro-Electric Power Plants
Steam Electric Generating Station

Liberal relocation allowances for you and your family.

Send Resume to Don Palmer
Industrial Relations Division

BECHTEL CORPORATION

220 BUSH STREET
SAN FRANCISCO 4, CALIF.

For personal interview phone:
Paul Keating, Murray Hill 7-7100, N. Y. City
Joe Braddick, Fairfax 3-2401, Houston, Texas
Bill Milligan, Tucker 1549, Los Angeles, Calif.

ELECTRIC UTILITY PERSONNEL

- **CHIEF POWER SYSTEM ENGINEER**
- **CHIEF TRANSMISSION & DISTRIBUTION ENGINEER**
- **POWER PLANT SHIFT SUPERVISORS**
- **CONTROL ROOM OPERATORS**

. . . for a Utility in Central America, consisting of a new high pressure 30,000 KW Steam Power Plant, an existing 10,000 KW Diesel Power Plant, 170 miles Transmission Lines, and Distribution Systems in one large city and 15 outlying towns. Minimum 5 years' experience. Good working conditions with initial contract for 2 years—with option for renewal. Working knowledge of Spanish desirable, but not necessary. All applications will be acknowledged. In reply, state age, experience, education, salary expected, and availability date.

P-2291, POWER
Class Adv. Div. P.O. Box 12, NY 36, NY

MECHANICAL DRAFTSMAN

Experienced in power plant piping. Wonderful opportunity. Comprehensive fringe benefits. Write stating education, experience and salary desired.

DUKE POWER COMPANY
Employment Office
P.O. Box 2178 Charlotte, N. C.

ASSISTANT MACHINE SHOP SUPERINTENDENT

Industrial firm in N. E. U. S. looking for a Mechanical or Electrical Engineer for a responsible and challenging position. Excellent opportunity for the man who qualifies. Company paid pension and insurance benefits.
Write stating age, marital status, desired salary and complete resume to

P2535 POWER
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

YOUR ORGANIZATION

Is it complete?

Are you expanding it?

Making Replacements?

Naturally, you are anxious to secure the most suitable man or men available. You want men with the special training that will make them an asset to your organization. You can contact such men through an advertisement in this Employment Opportunities Section of POWER

POWER

Classified
Advertising Division
330 W. 42nd STREET
NEW YORK 36, N. Y.

(Additional Employment Opportunity Advertising Continued on opposite page)

SEARCHLIGHT SECTION

(Classified Advertising)

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

UNDISPLAYED —RATES— **DISPLAYED**

(Not Available for Equipment Advertising)

$1.65 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.
Box Numbers count as one line.
Discount of 10% if full payment is made in advance for 4 consecutive insertions.

The advertising rate is $17.90 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.
An advertising inch is measured ⅞" vertically on one column, 3 columns, 30 inches to a page.

Send new ads or inquiries to Classified Adv Div. of POWER, P. O. Box 12, New York 36, N. Y.

MECHANICAL PLANT BETTERMENT ENGINEERS

M. E. GRAD. PREFERRED
5-15 YRS. EXPERIENCE

Operation and betterment of steam electric plants—Diesel experience helpful.
Permanent position.

Required by Operating Division of long established service and supervisory organization for large group of Electric Utilities located eleven Latin American countries. Some travel. Location New York. Usual employe benefits. Reply giving age, education, experience, personal particulars and salary expected.

AMERICAN & FOREIGN POWER COMPANY INC. AND SUBSIDIARIES
2 Rector Street, New York 6, New York
Personnel Dept. — DI 4-4400 — 14th Floor

TO THE FATHERS OF SONS NOW IN THE SERVICE

IF your boy is a recent college graduate soon to finish his Military Service, have him write to obtain details about an interesting career doing Sales Promotional Work with one of the largest and oldest metal producing companies.

P-2542, POWER
Class Adv. Div. P.O. Box 12,
New York 36, New York

ENGINEERING SUPERVISOR

Excellent opportunity for man with broad design and development experience in the manufacture of high pressure steam power plant auxiliaries. Must have good background in theoretical and practical thermodynamics and metallurgy.
Complete responsibility for Engineering function under direction of Manufacturing Vice President.
We are a well established, progressive, medium size, manufacturer with excellent growth potential, located in suburban Philadelphia.
All applications will be treated confidentially. Please send complete resume including salary requirements to:

P-2486, POWER
Class. Adv. Div. P.O. Box 12, N.Y. 3, N.Y.

MECHANICAL ENGINEERS

For interesting positions with a paper converting firm in N. E. U. S. Excellent opportunities for men wishing to associate and grow with a progressive organization. Positions immediately available for work in Design & Improvement of Production Machinery. Good retirement and insurance benefits.
Write stating age, marital status, desired salary and complete resume to

P2535 POWER
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

SALES ENGINEER WANTED

Well established pump manufacturer wants sales engineer familiar with paper and pulp industry to promote sale of pumping equipment in southeastern states. State education, experience and starting salary expected. Permanent position, unlimited opportunities. Our men know of this advertisement.

SW-2738, POWER
Classified Advertising Division
P.O. BOX 12, New York 36, N. Y.

GET 2nd ENGINEER PAPERS IN 1 YEAR

(Yes, get better stationary engineers License!)

No correspondence school bother. Nationally-known Chief Stationary Engineer Frederick C. Walker's 100-Question, 100-Answer Bulletins give you the straight dope quick. Send $3 to Walker & Collins, 524 Ashland Ave., Buffalo 22, N. Y. for first set today. Keep working. Save year.

LEFAX TECHNICAL DATA BOOKS

POCKET SIZE • LOOSE LEAF

Loose leaf, 6 hole, 6¾"x3⅜" bond paper, each book approx. 140 pages of technical data for student, engineer, technical worker. $1.25 ea.

Architecture
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Illumination
Electrician's Data
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Lumber Data
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Building Constr.
Reinf. Concrete
Piping Data
Surveying
Surveying Tables
Highway Eng'g.
General Math
Math Tables
Physics
Trig-Log Tables
Gen'l Chemistry
Chemical Tables
Analytic Geom.
Mech'l Drawing
Machine Design
Machinist's Data
Mech. of Materials
Pwr. Trans. Mech.
Thermo. Thls.
Phys. & Thermo.
Data
Metals
Metallurgy
Hydraulics
Radio
Television & FM
Electricity, AC
Electricity, DC
AC Motors &
Gen'trs.
Transformers,
Relays & Meters

Write for FREE catalogs (2000 listings). Send $1.25 book or $6 for any five books to

LEFAX PUBLISHERS, Dept. PG-3, Phila. 7, Pa.

Prepare for REFRIGERATION LICENSE

More than 300 multiple choice questions from past exams. Many sketches. 96 pages 8½" x 11". Send $3 to:

W. D. TURNER
44 West 63rd St., New York 23, New York

WANTED

Steam Engine Generator Sets • Turbines • Condensers • Generators • Boilers or Complete Power plants.

PAUL OBERMAN
1910 Delmar St. Louis, Mo.

WANTED

Second hand water tube boiler generating capacity 11,000 to 20,000 lbs. of steam per hour continuously. Please furnish detailed technical description, name of manufacturer and year built.

W2537 POWER
Class Adv. Div. P.O. Box 12, N.Y. 36, N.Y.

WANTED

B&W boilers sectional header type. Also fire tube boilers. Write to:

A. ROBERT GIBERT
P.O. Box 2702
Mexico City, D.F. MEXICO

MOTORS GENERATORS TRANSFORMERS — DIESELS

WORLD'S LARGEST INVENTORY
CASH FOR YOUR SURPLUS

ELECTRIC EQUIPMENT CO.
63 Curlew St., Rochester, N. Y.

Turbogenerators & boilers
Diesel generator units
Mercury arc rectifiers
Sub station equipment

OHIO POWER MACHINERY CO.
13661 Euclid Ave. Cleveland 12, Ohio

R U safe? Leading power men rate

STEAM ENGINEERING ERRORS

by a veteran examiner for issuing licenses the most practical work in this field. Many say—"There's more in that little book than in all my others." This one makes sense. Ordered in lots, at discounts, by utilities, boiler, chemical, paper, sugar mfrs., school districts and like groups to train operators and supervisors.

You'll enjoy it. 4th Ed. Send $2.00 to
The STEPLER Co. 1514 35th Ave. Seattle 22, Wash.

ROTARY CONVERTERS

2—1500 KW—G.E. Synchronous (Steel Frame), type HCC, form P, Serials 5227022 and 24, volts DC 600; AC and 3/60/440/720 RPM. With: 2-sets of 3—525 KVA—G.E. transformers, type ABJ, form F, 1 ph., 60 cy., 13800/445 volts, Air Press. 1 oz.

Complete on original foundation.
Priced low, before removal.

JARRAP CORPORATION
2416 Richmond St., Phila. 25, Pa.
GA. 6-8227 & 6-2680

AIR COMPRESSOR

Ingersoll Rand—Steam driven—2600 CFA per minute. Model #19430 & 30 & 19x24 XPV. Serial No. AX41516.

PURCHASING DEPT.
PORTER-CABLE MACHINE CO.
SYRACUSE 8, NEW YORK

NEW 8" ANGLE VALVES

Steel, flanged, 150 lb. pressure. Just acquired from Government surplus.

The Boston Metals Co.
313 E. BALTIMORE STREET
Baltimore 2, Md.—Lexington 9-1900

BELYEA RE-NU-BILT
LARGE ELEC. POWER EQUIPMENT
SELECTED STOCK ITEMS

RE-NU-BILT—GUARANTEED—RE-NU-BILT

COMBINATION MILL DRIVES — 15/2500 HP
D.C. MOTORS WITH M.G. SETS & CONTROLS

Qu.	MAKE	TYPE	VOLTS	R.P.M.
1—2200 HP	G.E.	MCF-12	600	400/500
2200 KW	G.E.	Syn.	2300/4600	514
1—1250 HP	G.E.	MCF	600	600/750
1000 KW	G.E.	Syn.	2300/4600	720
1—1000 HP	G.E.	MCF-8	600	350/700
1000 KW	G.E.	Syn.	2300/4160	720
1— 200 HP	G.E.	CD-1650Z	250	500/1500
200 KW	Whse.	Syn.	440	1200

ALSO MANY OTHER COMBINATIONS

A. C. MOTORS—3 Ph. 60 Cy.

SLIP RING

Qu.	H.P.	Make	Type	Volts	Speed
1	1500	G.E.	MT	4000	257
1	1500	G.E.	MT	6000	1187
1	1100	G.E.	IM	2300	720
1	1000	A.C.	Mill	2300	240
1	800	G.E.	MT	2300	293
1	750	G.E.	MT-573	2300	1199
1	700	Al. Ch.	D.P.	2300	300
1	500	Whse.	CW	550	550
1	400	Whse.	CW-966A	440	1176
1	400	Whse.	CW	440	514
1	400	Whse.	CW-1218	2200	433
1	350	G.E.	IM-17A	440/2200	720
1	250	G.E.	MT-424Y	4000	257
1	250	A.C.		550	600
1	200	G.E.	IM	2300	880
1	150	Whse.	CW-20E17	2300	435
2	125	A.C.	ANY	440	880

SQUIRREL CAGE

1	800	G.E.	KT-572	2200	1180
3	600	G.E.	PF-550HT	440	3570
2	450	Whse.	CW-1420	2300/4150	884
1	400	G.E.	IE-15B	2300	1165
1	400	G.E.	IE	2300	500
1	300	G.E.	IK-17	440	580
3	300	G.E.	KT-507	440	1800
1	150	Whse.	CS	440	580

SYNCHRONOUS

1	7000	GE	ATI	2240/6600	600
1	4350	C.W.	8501-8L	13800/6000	514
3	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TS	2300	600
2	1000	Whse.		2300	150
1	1100	G.E.	ATI	2300/4600	900
2	500	G.E.	TS-7567	2200	1200
1	450	Whse.		2200	450

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
1	3000(3U)	G.E.	514	600	4000/6600/13200
2	2000/2400	G.E.	450	250/300	2300/4600
1	2000	G.E.	500-25sg	650	11000
2	2000	G.E.	514	600	4600/2300
1	1750/2100	G.E.	514	250/300	4800/2400
1	1500	G.E.	720	600	6600/13200
1	1500	G.E.	514	250	2300/4600
1	1250	Whse.	720	600	2300
1	1000	G.E	900	250	6600
1	750	Whse.	900	250	2300/4150
1	750	G.E.	720	125/250	2300/4600
1	500	Whse.	900	125/250	440
1	150	Whse.	1200	600	2300
1	150	Whse.	1200	275	2300

WELDING M.G. SET

Gen. Elec.—1100 Kva—0.7 p.f.—2300/4600 V. 3/60 Generator with 1750 Kva—.8 p.f.—2300 V. 3/60 motor complete with exciter set and controls.

TRANSFORMERS

Qu.	KVA	Make	Type	Ph.	Voltages
1	3000	A.C.	OISC	3	23000x2400/4160
1	2500	Al.Ch.	OISC	3	34500x13800
1	2500	Al.Ch.	Pur.	3	13800x14F/11B
3	500	Kuhl	OISC	1	13800x4900
3	333	G.E.	HS	1	7200x2400x4160Y
3	333	G.E.	HSWR	1	2300/4000x230/460
3	333	G.E.	HD	1	13200x2530x4950Y
3	300	Whse.	OISC	1	13200x120/240

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltages
1	5000	G.E.	60/50/60	6600/11000/6600
1	2500	G.E.	25/62.5	2300/2300
1	1000	G.E.	25/56.3	4400/2300
1	500	Al. Ch.	25/60	11000/2300

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4000	G.E.	Condensing 425 — 750 F.T.T. Surface Condenser 3/60/2300/4000 V Direct con exciter.
1	1500	Whse.	Auto extraction 190 lbs. — 650° F.T.T. 60 lb. extraction 3/60/240 V. Dir. conn. Exc.
1	1000	Moore	Auto-Ext. Cond 175/200# U.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300. Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.S.P., 450/3/60.

BELYEA COMPANY, INC.
43 Howell St., Jersey City 6, N. J.

Rebuilt HEMPHILL Guaranteed EQUIPMENT

TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
2	750	G.E.	H	1	4600-120/240
1	750	G.E.	HT	3	4150Y-220/440
2	250	G.E.	H Pyranol	1	2400-4800/8320Y-120/240
2	250	West.		1	2300/4600-230/460
3	200	G.E.	H-KD	1	12800/13420/4600-240/480
3	200	G.E.	H	1	7800/15600-220/440
1	150	Pirler	OA	1	4160-240/480
3	50	Penn	OISC	1	2400/4160Y-240/480
3	50	G.E.	H	1	2400/4800-120/240
1	25	G.E.	H Pyranol	1	2400/4160Y-120/240
6	15	Maloney	KL	1	2400/4160Y-120/240

SYNCHRONOUS MOTORS

Qu	HP	Make	Speed	Type	Volts
1	100	G.E.	900	TS	2300
1	125	G.E.	600	TS	2300
1	125	E.M.	500		4800
1	150	G.E.	1800	TS	220/440
2	150	Allis-Ch.	300		2300
1	150	West.	900		220
1	300	E.M.	720	TEFC	2300
1	500	West.	450	HR	440
1	1000	West.	580	Mill	2300/4150

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
1	15	G.E.	900	MT-542	440
1	25	G.E.	900	MT-526	440
1	60	G.E.	1800	MT	220
1	60	Ideal	900	AV	220
1	75	G.E.	600	IM	440
3	150	Allis-Ch.	1800	AY RW	2300
1	200	West.	514	CW	440
1	250	West.	600	CW	440
1	350	West.	1800	CW	2300
1	500	G.E.	1200	M	2400/4150

SQUIRREL CAGE

Qu	HP	Make	Speed	Type	Volts
1	75	G.E.	1800	K-4458	440
1	100	West.	1160	CS	440
1	100	L-Allis	1770	RX.T.E.F.C.	440
1	150	G.E.	720	KT-562	440
2	250	G.E.	1790	K.-T.E.F.C.	2300

MOTOR GENERATOR SETS

Qu	K.W.	Make	Speed	Volts DC	AC
1	10	G.E.	1800	125	220/440 V.
1	30	G.E.	1800	125	220/440 V.
3	60	E.M.	1200	125	220 v. 3ph.
1	75	G.E.	1800	250	440 v. S.C.
1	150	CR. Wh.	600	125	220/440
1	300	G.E.	1200	250	2300/4160Y
1	1000	West.	720	600	2300/4160Y S.R.

D.C. 230 VOLT MOTORS

Qu	HP	Make	Speed	Type
1	20	G.E.	1650/1800	CDM 85
3	30	C.W.	700	CM
1	25	G.E.	880	RC
2	75	C.W.	900	WP
1	125	G.E.	1700	RC
2	150	C.W.	900	WP

A.C. HOIST MOTORS

Qu	HP	Make	Type	Speed	Volts
1	25	G.E.	MTC	565	440
2	300	G.E.	ITC-5017	600	440

FOR POWER
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STEAM TURBINE DRIVEN

GPM	TFH	Stage	Mfg.
450	802	4	Worth. (2)
500	850	4	Worth.
200	1375	6	Ingersoll R. (2)
200	830	2	Weisman (2)
100	1320	4	De Laval
750	725	4	Worth. (2)

MOTOR DRIVEN

GPM	TFH	Stage	Mfg.
740	2250	5	Worth.
700	1850	6	Worth.
675	1100	5	LeCourtenay
500	1050	5	Worth. (3)
100	1150	5	Gould

UNDERWRITERS FIRE PUMP

GPM	TFH	Stage	Mfg.
1000	231	1 (motor drives)	Fairbanks
750	231	(gas. drives)	Allis Chal. (2)

MOTOR DRIVEN SAND PUMPS

Americus Manganese 10"
Allen-Shafer-Hoff 14"

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(4) size #2, 850 R.P.M., 10# pressure, 248 C.F.M.; 660 R.P.M., 180 C.F.M., when used as a Vacuum Pump.

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3600 RPM 185 PSIG 30# BP

1000 KW G.E. Cond. Extr. 3/60/480 V
3600 RPM 225 PSIG 20# extr.

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Full line power equipment.

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2—150 HP UNION WATER TUBE, 160 PSI.

1—250 HP B&W, 150 PSI.

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D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
200	Reliance	1400-T	230	850
175	Cr. Wh.	151-H	230	600
150	Whse.	SK-154	230	850
100	Reliance	651-T	550	1000/1600
100	Reliance	651-T	230	575/1150
75	F. Morse b.b.	DH-140	115	1600
65	Cr. Wh.	CMC	230	575/1150
60	Allis Ch.	K-146	230	1150
50	G.E. (2)	CD-125	230	600/1200
50	G.E. b.b.	CD-93		2500
40	Reliance b.b.	181-T	550	1750
20	Imperial b.b.	D-69	230	600/1600

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V.
300	Gen. Elec.	2200/440 AC	250 DC
200	G.E. converter	220/440 AC	250 DC
200	El. Machy.*	2300/440 AC	250 DC
200	Whse.*	220/440 AC	56 DC
200	Gen. Elec.*	220/440 AC	135 DC
200	Whse.*	220/440 AC	250 DC
175	Gen. Elec.	220/440 AC	250 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
100	G.E.*	2200/440 AC	135 DC
100	Whse.	220/440 AC	250 DC
75	Cr. Wheeler	25 cycle	125 DC
75	Whse.	2200/440 AC	600 DC
60	Whse.	220/440 AC	250 DC
50	Gen. Elec.	220/440 AC	125 DC
50	Whse.	220/440 AC	250 DC
25	Whse.	220/440 AC	250 DC

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	G.E. (2)	CY-275	250	1200
200	Reliance	1400-T	250	1200
150	Whse.	SK-154	250	1150
150	Cr. Wh.	CCD	250	850
100	Whse.	SK-180	250	900
100	Allis Ch.	E	125	1200
100	Reliance	651-T	600	1200
75	Whse. b.b.	SK-163	125	1800
65	Allis Ch. (2)	E-146	250	1500
50	Gen. Elec.	CD-118	250	1200

A. C. MOTORS — 60 CYCLE

HP	Mfr.	Type	Volts	Speed
700	Allis Ch.	Sq. Cage	440	900
600	G.E.	Slipring	2200	600
500	G.E.	Sq. Cage	2200	3600
500	Whse.	Slipring	2200	450
500	G.E.	Sq. Cage	4000	1800
450	Allis Ch.	Synch.	480	600
400	Whse.	Sq. Cage	2300	514
400	Marathon (2)	Sq. Cage	2300	3600
350	G.E.	Sq. Cage	2200	1800
300	G.E.	Slipring	2200/440	600
300	G.E.	Sq. Cage	440	900
300	Whse.	Synch.	440	1200
300	Gen. Elec.	Slipring	220/440	1200
300	G.E.	Slipring	440	450
250	G.E.	Slipring	440	1200
250	G.E.	Sq. Cage	2200/440	1200
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E.	Slipring	220/440	720
250	Gen. Elec.	Synch.	220/440	450
250	G.E.	Synch.	220/440	720
250	L.A. (2)	Sq. Cage	220	1800
225	G.E.	Synch.	220/440	900
200	G.E. b.b.	Slipring	2200/440	720
200	Whse. (2)	Slipring	2200	514
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	440	450
200	Gen. Elec.	Sq. Cage	220/440	720
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	E.M.	Synch.	220/440	1200
175	G.E. (2)	Synch.	220/440	720
150	El. Machy.	Synch.	220/440	360
150	G.E.	Slipring	2200/440	720
150	G.E. (4)	Slipring	2200/440	600
150	G.E. (2)	Sq. Cage	2200/440	720
125	Whse. TEFC	Sq. Cage	2200/440	720
125	Gen. Elec.	Slipring	440	600
125	G.E. TEFC	Sq. Cage	220/440	3600
125	Ideal	Slipring	4000/2200	900
100	Whse (2)	Sq. Cage	2300	900
100	G.E.	Slipring	220/440	450

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SPECIAL OFFERINGS

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1—1000 KW—240 volts—130/250# Condensing Auto. Extraction—15#—New 1945

1—1000 KW 480 volts—225# Condensing Auto. Extraction—20#

1— 400 KW—550 volts—400# Condensing Auto. Extraction—29/50# New 1948

1— 300 KW—480 volts—210# Condensing Auto. Extraction—40#

1— 250 KW—240 volts—130#—Non-Cond. 10/12# Back pressure

TRANSFORMERS

2—15,000 KVA—132,600Y—13,800 volts

3— 8,333 KVA—66,000/38,000/11,000/6600 volts

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1—300 HP Louis Allis Wound Rotor Induction Motor

1800 RPM—3/60/440 V—Sleeve bearing.

With this motor goes complete set of speed regulating controls as follows:

2—Machine duty grids in two cubicles.
1—Primary magnetic contractor in cubicle.
1—Drum Controller.

Price F.O.B. Syracuse, N.Y. $5,250.00

The Above Equipment is Brand New

1—500 HP Louis Allis Wound Rotor Induction Motor

1200 RPM—3/60/440V—Sleeve bearing.

With this motor goes complete set of speed regulating controls as follows:

2—Machine duty grids
1—Primary magnetic contactor
1—Drum Controller

This motor is rebuilt and the guarantee is the same as for a new motor, one year.

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DIESEL GENERATOR SETS

1—720 HP Fairbanks Morse Model 33, 5 cyl. 257 RPM, 580 KVA F-M 3/60/2400 V generator.

1—560 HP Fairbanks Morse Model 33, 4 cyl. 257 RPM, 470 KVA F-M 3/60/2400 V generator.

1—750 HP Superior 8 cyl. 400 RPM, 500 KW Elec. Mchy. 3/60/2400 V generator and auxiliaries.

1—400 HP Superior 4 cyl. 400 RPM Model VDSE, 250 KW, 3/60/2400 V.

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3 15,000 KVA G.E. H-DHJ
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Automatic tap changing on the load
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SLIP RING MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts
(*2300 Volts or Higher)

H.P.	MAKE	TYPE	SPEED
2000	*G.E.	MT	600
1500	*Westg.	CW	600
1200	*Al-Ch	ANT	1800
1000	*Westg.	CW	450
700	*Al-Ch	ANY	720
600	*G.E.	MT	450
500	Westg.	CW	600
500	Westg.	CW	350
300	G.E.	IM-17B	600
250	*G.E.	I-M	450
200	Westg.	CW	900
200	G.E.	IM	600
200	Westg.	CW	514
200	Westg.	*CW-956A	514
150	Cr-Wh	50-R	1800
150	G.E.	MT-540	1800
150	*Wagner	RS-131	900
150	Westg.	CW	450
125	G.E.	IM-15A	600
100	G.E.	IM-13A	1080
100	G.E.	MTC-5546	900
100	G.E.	I-M	720
100	G.E.	IM	600
100	G.E.	IM-15A	450
75	G.E.	MT-347	1200
75	G.E.	IM	1200
75	Al-Ch	ARY-223C	1200
75	G.E.	MT-356	900
75	Al-Ch	ANY-26F	900
75	Al-Ch	ARY	720
75	G.E.	IM	600
60	Al-Ch	ARY	1200
60	G.E.	MT-546	1200
60	G.E.	*MT-536	1200
60	*Westg.	CW-762C	900
50	*Al-Ch	ARY-220-BS	1800

SLIP RING MOTORS

Crane & Hoist Service
3 Phase, 60 Cycle, 220 or 440 Volts

H.P.	MAKE	TYPE	SPEED
80	G.E.	MTC-5552	600
75	Westg.	CI-756A	600
50	Westg.	MW-534	600
50	G.E.	HIC-TENV	600
35	G.E.	MTC-5536	600
20	Westg.	CI	1200
11	Westg.	CI-E464	900
10	P & H	BW-6	1800
8	P & H	BW-6	1200
5	N. West.	WRC	1200
3	G.E.	MTC-5944	900

PUNCH PRESS MOTORS

NEW—3/60/220-440 volt
High Torque—Hi Slip

H.P.	MAKE	TYPE	SPEED
75	Fr. Morse	QFZK	1065
60	Westg.	CS-752C	1000
40	Reliance	AA-B-505	1635
30	L-Allis	CK-445	1050
30	Wagner	RP-444	1050
25	Reliance	AA-C-504	1100

PLATERS

AMPS	MAKE	VOLTS
7500/3750	El. Prod.	6/12-220/440
2000/1000	Chasdy.	6/12-220/440
1500/750	Chasdy.	12/24-220/440
1500/750	Chasdy.	6/12-220/440
1000/500	Chasdy.	12/24-220/440

SQUIRREL CAGE MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts
(*2300 Volts or Higher)

H.P.	MAKE	TYPE	SPEED
1250	*Al-Ch	ANX	3600
1200	*Al-Ch	ARW	1200
750	*Westg.	CS	600
500	*Al-Ch	ARW	3600
500	*G.E.	KT5608	900
500	G.E.	KT-424	450
400	G.E.	KT-424	720
250	Westg.	CS-Tefc	1800
250	G.E.	KT-580	1800
250	*L-Allis	GEX-148	720
250	*G.E.	IK	600
250	G.E.	IK-17A	600
250	Westg.	CS-14	514
200	*G.E.	FT-540Y	3600
200	*G.E.	IK-13B	1800
200	G.E.	KT-564	900
200	Al-Ch	ARW WT	600
150	G.E.	IK-13B	1200
150	*Al-Ch	AN-30F	1200
150	G.E.	IK	900
150	*Westg.	CS	600
125	*Westg.	CS-771 Seaf	1800
125	*Al-Ch	AR	1800
125	Al-Ch	AR-220 CS	1800
125	*Reliance	AA 6985	900
100	Westg.	CS 5078 TEFC	3600
100	*Westg.	CS	1800
100	*G.E.	FT-542Z	1800
100	G.E.	FYRP-543	1800
100	*Westg.	CS-760D	1200
100	G.E.	KT-508	1200
100	G.E.	IK	1200
100	Al-Ch	AW-230	1200
75	Al-Ch	KF-445B	3600
75	G.E.	KF-445Z	3600

D. C. MOTORS

H.P.	MAKE	TYPE	SPEED
250	Westg.	SK-230	450/900
200	Westg.	SK-201	900
200	Cr. Wh.	CM	900
175	G.E.	ELC	750
100	G.E.	MPC	400/900
100	G.E.	RC-34	2300
100	G.E.	RC-19	575
100/150	G.E.	MCF	300/1000
50	Cr. Wh.	CMC	700/1100
50	G.E.	DLC-204	850
33	Westg.	SK-150	350/1000
30	Cr. Wh.	CCM-504	450
30/40	G.E.	CD-115	500/1500
25	G.E.	RC-52	850
25	Westg.	SK-153	575
20/25	Westg.	SK-151L	250/1000
20	Star	BH-10	1750
15	Westg.	SK-103	400/1600

M.G. SETS

K.W.	MAKE	A.C.	D.C.
1250	Westg.	6600/4160	600
1000	G.E.	12,000	600
500	Westg.	2300	275
300	Westg.	2300/440	230
400	A.C.	2300	120/240
200	G.E.	2300	230/275
200	Westg.	2300/4000	230/275
200	Ridgeway	2300	230
170	G.E.	220	115
150	G.E.	2300	125/230
150	A.C.	2300	275
150	Westg.	2300	125/230
150	G.E.	440	275
125	Cr.Wh.	4160	125
100	G.E.	*300	230
100	Al-Ch	2300	230
100	El.Mch.	440	125

CHICAGO *Electric Co.*

1320 WEST CERMAK RD, CHICAGO 8, ILL.

NEW 25 CYCLE — MOTORS AT LONG DISCOUNTS

Qu.	HP	Make	Phase	Volts	Brg.	Frame	RPM
16	¼	Wag.	1	110/220	SL	48X	1425
9	½	Wag.	1	110/220	SL	48X	1425
10	½	Whse.	2	220/440	SL	145	1425
8	¾	Whse.	3	220/440	SL	184	1425
3	¾	Whse.	3	550	BB	184	1425
3	¾	G.E.	3	220	SL	TT	1425
3	1	L.A.splash	3	550	BB	224	1450
5	1	Whse.	3	220/440	SL	FX324	1450
7	2	L.A.splash	3	550	BB	FX325	1450
5	3	L.A.splash	3	550	BB	FX254	1450
1	5	L.A.splash	3	550	BB	FX284	1450
3	10	L.A. XP	3	220/440		JEX364	1450
1	15	G.E. used	3	220/440		405	1450
1	25	Rel. XP	3	220/440		405	1450

TRANSFORMERS

80—1½ KVA, Line Material, Dry type, 120/240/480 volt primary to 120/240 volt secondary with taps, 1 phase, 60 cycle

9—250 KVA, General Electric, OISC, 2300 volt primary, 460/230/115 volt secondary, 1 phase, 60 cycle

6—500 KVA, Westinghouse, OISC, 2300 volt primary, 460/230 volt secondary, 1 phase, 60 cycle.

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World's Best Rebuilts

95 CFM	1500 PSI	6½-3⅞x1¾x7	Chicago YCB3
138 CFM	100 PSI	7x7	Ingersoll ESI
234 CFM	100 PSI	9x9x9	Chicago 54, (new)
268 CFM	500 PSI	10-4½x10	Ingersoll XOB
343 CFM	500 PSI	11-5x13	Worth, (new frame)
464 CFM	100 PSI	12x11	Gardner RX
478 CFM	100 PSI	11½x7x7	Worthington YB2
552 CFM	100 PSI	13-6x12	Ingersoll XRB
593 CFM	100 PSI	13½-8x8	Ingersoll XRE2
676 CFM	100 PSI	15-9½x12	Ingersoll XRB
640 CFM	100 PSI	16-10x10	Pennsylvania DE2
827 CFM	100 PSI	17-10½x14	Ingersoll XRB
1665 CFM	42 PSI	16-16x16	Ingersoll XREC
1723 CFM	110 PSI	140 lbs. st	Ingersoll XPV

Portables—Worthington 60 to 660 CFM

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NORTH BERGEN, N.J.
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37 Years Dependable Service

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
800	2300	Whse.	900
500	2300	G.E.	450
450	440	Whse.	514
400	4000/2300	Whse.	450
400(2)	2300	G.E.	900
300	2300/440	G.E.	720
300	440	G.E. (hoist)	600
300	440	Whse.	3600
250	2300/440	G.E.	1200
250	440/220	Whse.	600
250	550/440	G.E.	1200
225	4000/2300	G.E. (hoist)	600
200	440/220	Whse.	514
150(2)	440/220	G.E.	720
150	2200/440	G.E.	600
125	550/440	G.E.	1200
125	2200	G.E.	600

SYNCHRONOUS MOTORS 3-Ph 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G.E.	ATI	720
375	2200	Whse.	G	900
350	440/220	El. Machy.	Syn.	1360
300	2300/600	G.E.	TS	720
300	2200/440	G.E.	TS	1200
250	2200/440	G.E.	TS	720
250	440/220	Whse.	HR	277
250	440/220	G.E.	ATI	600
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
600	2200	G.E.	FT	3600
500	2300/4000	Elliot	SC	1800
400	2300/4000	Whse.	CS	720
400	2300/4000	G.E.	K	1800
350	440	G.E.	KT	1200
300	2300/4000	L. Allis	FS	1800
250	2300	Whse.	CS	900
250	2300	G.E.	K	900
225(2)	2200/440	G.E.	KT	1200
200	440/220	G.E.	KT	1600
200	2300/440	G.E.	JK	600
200	2300	G.E.	KT	1800
150	2200	Al. Chal.	AR	1800
150	220	Whse.	CS	1200
150	440/220	G.E.	KT	720
150	2300/440	G.E.	KT	600

A. C. GENERATORS

1—320 kva, 600 rpm 2300/440/220 V., G.E.
1—300 kva, 900 rpm, 2200 V, Whse.
1—225 kva 60 rpm, 220/440 V, G.E.
1—200 kva, 720 rpm 2300/440 V, G.E. (Ball)
1—187 kva, 1200 rpm, 2300/440 V, Whse.

CIRCUIT BREAKERS

2—2000 amp. GG R., 3 pole, 600 V.
2—1600 amp. ITE, 3 pole, 600 V.
6—FKR-150-28, 600 amp., 15,000 V, G.E.
1—400 Amp., Conduit, 3P, 25 KV outdoor
1—400 Amp., B. Smith, 3P, 7.5 KV outdoor

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
225	230	Whse.	SK	2870
150	230	El. Dyn.	S/brg.	600
150	230	Whse.	SK	1750

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Type	Output V., DC
250	Whse.	2200	Syn.	250
240	G.E.	4000/2300	Syn.	250
175	G.E.	220/440	Syn.	230
150	Whse.	440/220	Sq. Ca.	275
125	G.E.	4000/440	Syn.	115
125	G.E.	440/220	Syn.	250/125
100	Al. Ch.	220/440	Sq. Ca	240/120
60	G.E.	2300/440	Sq. Ca	230

TRANSFORMERS 60 Cy.

1—1000 kva, Whse., 13,800—2300 V, 3 ph., New
1—600 kva, Standard, 13,800—2300 V, 3 ph.
3—333 kva, G.E., 23000/11500—2300 V.
3—333 kva, Mod. 13,800—2300 V.
3—333 kva, G.E., 2400—480 V.
2—300 kva, G.E., 4150—240 V., 3 ph., Pyr.
3—200 kva, Mod., 13,800—2300 V.
3—200 kva, G.E., 2300—575 V.
2—100 kva, Al. Ch., 2400—480/240 V

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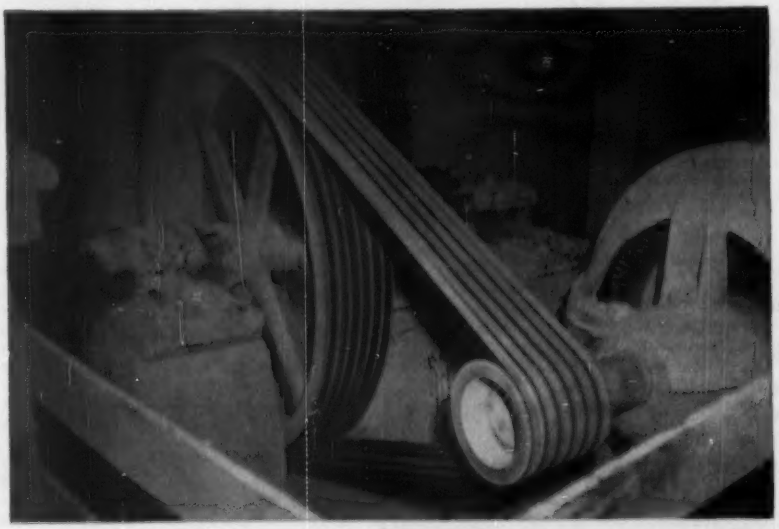

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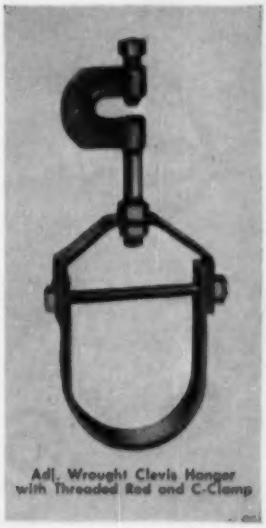
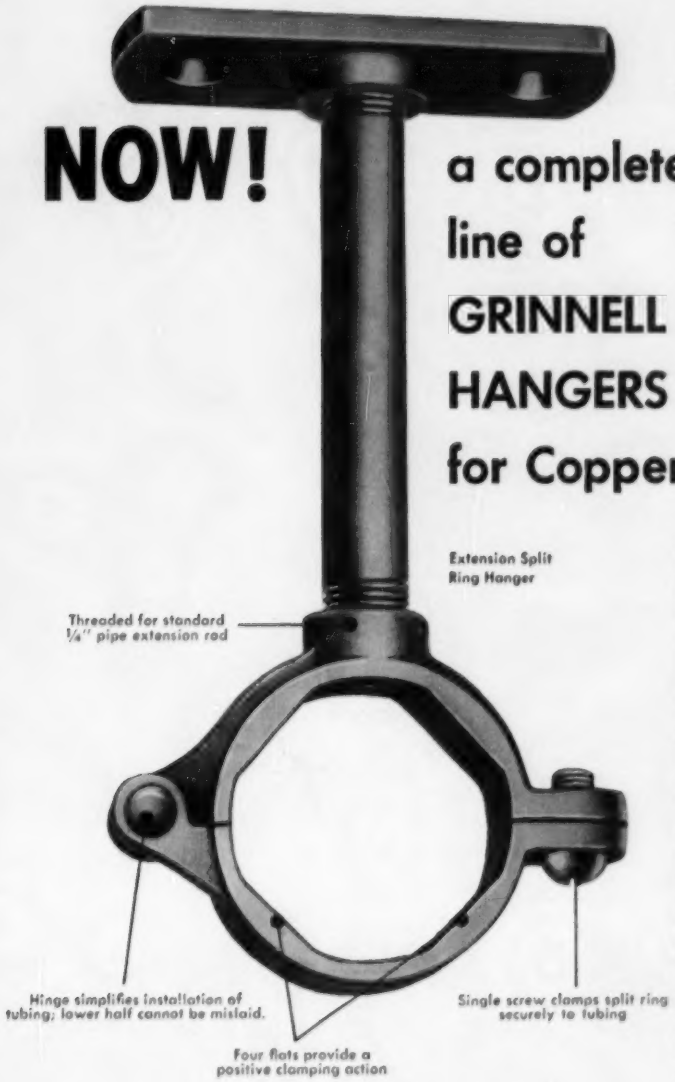


Adj. Wrought Clevis Hanger with Threaded Rod and C-Clamp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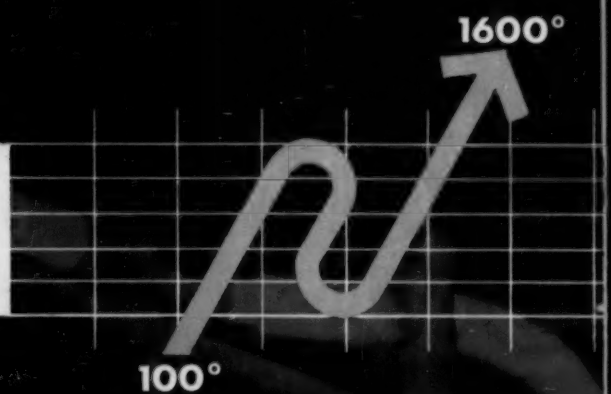

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